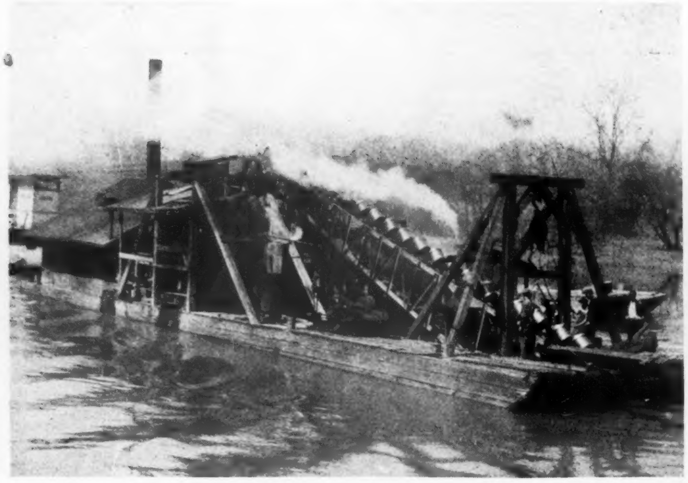
Volume XXX April 30, 1927 Number 9

Rock Products

With which is Incorporated CEMENT and ENGINEERING NEWS

Founded 1896

WHARF derrick and derrick boat unloading a barge at the Knoxville Sangravel Materials Co. plant. The derrick boat is typical of those used by nearly all the sand and gravel producers in the Knoxville, Tenn., district. The flush-deck barge without cargo box, peculiar to the locality, is also shown.



Ladder dredge of H. C. Milnor Co.

Dipper dredge of the Knoxville Sangravel Materials Co.

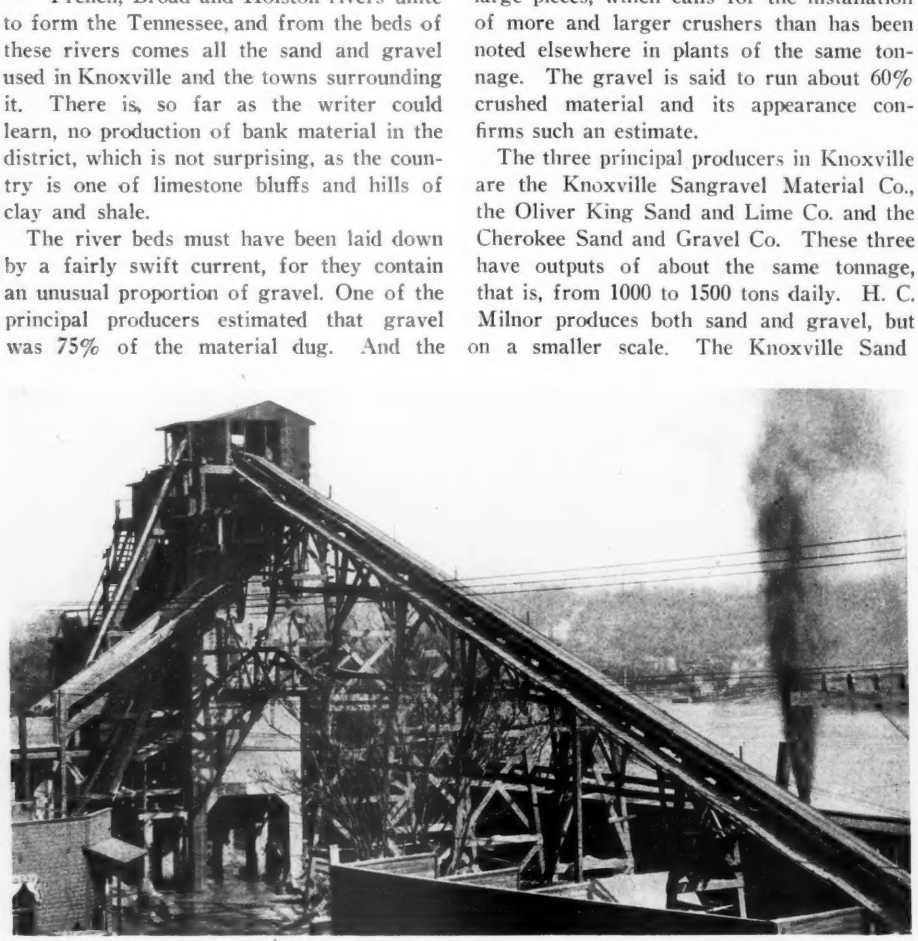
Dredging Sand and Gravel on the Upper Tennessee River

Small but Well Designed Plants of Good Construction Operate in District—Dipper Dredges Found Most Economical

NOT far from Knoxville, Tenn., the French, Broad and Holston rivers unite to form the Tennessee, and from the beds of these rivers comes all the sand and gravel used in Knoxville and the towns surrounding it. There is, so far as the writer could learn, no production of bank material in the district, which is not surprising, as the country is one of limestone bluffs and hills of clay and shale.

The river beds must have been laid down by a fairly swift current, for they contain an unusual proportion of gravel. One of the principal producers estimated that gravel was 75% of the material dug. And the gravel contains an unusual proportion of large pieces, which calls for the installation of more and larger crushers than has been noted elsewhere in plants of the same tonnage. The gravel is said to run about 60% crushed material and its appearance confirms such an estimate.

The three principal producers in Knoxville are the Knoxville Sangravel Material Co., the Oliver King Sand and Lime Co. and the Cherokee Sand and Gravel Co. These three have outputs of about the same tonnage, that is, from 1000 to 1500 tons daily. H. C. Milnor produces both sand and gravel, but on a smaller scale. The Knoxville Sand and Lime Co. produces only sand, and so does the Miller Sand Co., which sells its entire output to the Knoxville Sangravel Materials Co.



Washing and screening plant of the Cherokee Sand and Gravel Co.

Well-Built Plants of Good Design

Although none of these plants have more than a moderate tonnage output, if one compares them with the 100-car and even 200-car plants that are being built near the larger centers of population, they are remarkably well built and operated. Concrete has been freely used for bins and foundations and sound heart timber for buildings and superstructures. Two of the plants have installed well designed storage systems employing belt conveyors. In all plants visited the designing had been carried out on good principles and the whole operation went on smoothly from the time the material was received at the dock until it passed to the storage piles as a washed, screened and crushed-to-size product.

The most difficult condition which the sand and gravel industry had to meet in establishing itself in this locality was that of digging the material. The available market did not permit very large investment in equipment and the price for which the material had to be sold in competition with crushed stone made an economical method necessary. Somewhat similar conditions are to be found in the Ohio river near Pittsburgh, that is the river bed contains more gravel than sand and the material is packed hard. At Pittsburgh the problem has been solved by the use of very large and powerful ladder dredges, expensive to build but

justified because they are economical in producing the large tonnage, for which there is a ready market in the Pittsburgh district, as well as being able to dig the tightly packed material from the bed of the river. But the cost of one of these machines runs into hundreds of thousands of dollars—much more than would be justified by the Knoxville market.

Knoxville Sangravel Materials Co. plant

Dredge Types and Dredging Practice

The pump dredge, the great standby of the sand and gravel producer of the middle west and south, was tried out early in the game by one producer and reported a failure. The ladder dredge was tried and is still in use, but mainly for dredging sand bars where the heaviest digging is not encountered. The bucket dredge came next, a barge mounting an A-frame derrick with a clamshell bucket. Such dredges also have remained in use and are fairly successful as diggers and economical to operate. Last of all came the dipper dredge, a kind of floating steam shovel, much used by the government and by contractors in river dredging and canal digging but very little used in the sand and gravel industry. It is conceded to be the most successful type of all. It is able to dig anywhere in the river, it can handle the largest pieces and it is considerably faster than the derrick boat or bucket dredge. A skillful operator can do some surprising things with one of these dredges. The writer watched one "herding" barges one morning, pushing them to one side or the other and lining them up for the steamboat to take in tow, by using the side of the dipper and swinging the boom, and it was astonishing to see how quickly the barges were handled in that way.

There are two fair sized dredges of this type at Knoxville, an Osgood originally built for the government of the United States, and used in its river work and now owned by the Oliver King Sand and Lime Co. Besides this the same company operates two bucket dredges and a ladder dredge. The other dipper dredge was built by the Marion Steam Shovel Works for the Knoxville Sangravel Materials Co. It has a 1-yd. dipper, but it is fast enough to keep the washing plant supplied with material except in the peak of the season when a bucket dredge is also employed.

All the larger companies have dredges of the bucket type, more usually spoken of as derrick boats. All that were seen were very substantially built machines. That owned by the Sangravel company was built at the plant and has a Clyde 3-drum steam hoist and a derrick, of the same make, with a 50-ft. boom. A Blaw-Knox 1-yd. bucket and a "Bull Dog" 1½-yd. bucket are both used. At times this boat is used to help the shore derrick unload barges at the landing which illustrates what a useful machine such a derrick boat may be, as it can load and unload heavy pieces of machinery as well as sand and gravel, or go out and dig the day's production if that is desired.

A new derrick boat being built by the Sangravel company has a center hopper below which are two conveyors extending over the sides of the hull for loading barges. This will be used for digging sand.

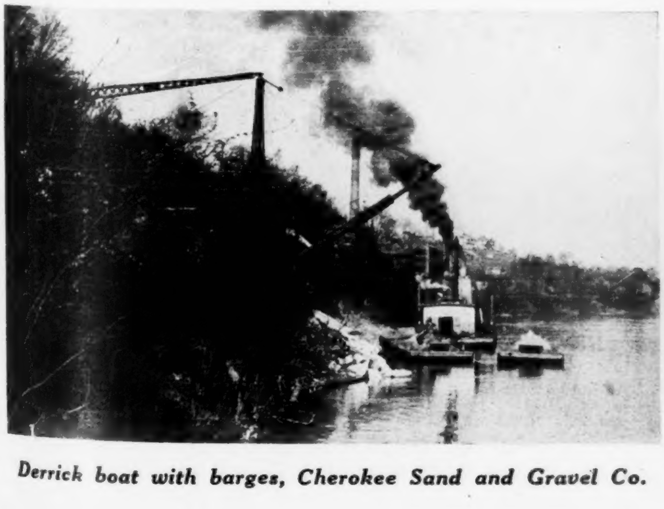
The ladder dredge of the Knoxville Sand and Lime Co. was being reconstructed at the time Knoxville was visited, which gave a chance to inspect the machine in detail. The hull is 108 ft. long and 22 ft. wide and when loaded it draws 24 in. The ladder which is 52 ft. long works in a center well, like those of the big dredges of the Pittsburgh district and it is made of structural steel members and bracing, and not of plates and channels as the ladders on the larger dredges are made. It is handled by an American hoist. Steam is employed for power, a Whelan center-crank engine being used on the bucket line. The buckets have a little more than 1 cu. ft. capacity each

New derrick boat under construction by the Knoxville Sangravel Materials Co.

and, with the remainder of the dredging equipment, they were furnished by the Webster Manufacturing Co.

Barge Loading Practice

The barges which the dredges load are all of the flush deck type and have one feature



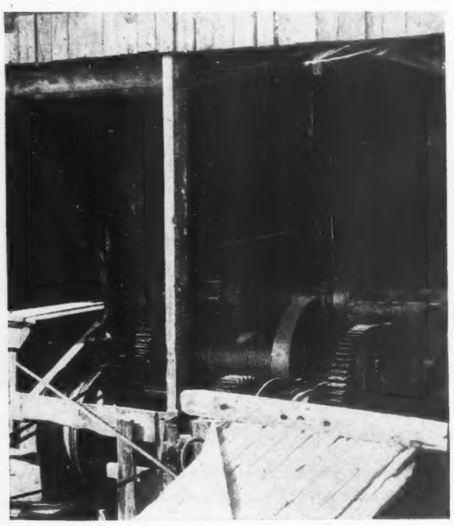
Derrick boat with barges, Cherokee Sand and Gravel Co.

Barge landing of the H. C. Milnor Co.

Warehouses and landing at the plant of the Knoxville Sand and Lime Co.

Reconstructing a ladder dredge at the Knoxville Sand and Lime Co.'s landing

that the writer has not seen elsewhere—they are without a cargo box. The load is simply piled on the deck. This is done to make



Derrick hoist at the Oliver King Sand and Lime Co.'s plant

it easier for the bucket at the landing place to clean up the load, but the loss in capacity is so great that one wonders if it is worth what it costs. Assuming the usual angle of repose, the material *might* be piled high enough to be about 88% of the load, which could be carried in a cargo box 2 ft. deep. (This is assuming a 25-ft. wide scow with a cargo box 24 ft. wide.) But no loads which the writer saw were ever piled to anything like such a height, and to do so would raise the center of gravity higher than would be advisable. Looking at the loaded scows as they come into the dock would lead one to believe that they are not loaded to more than 50% of the capacity with a cargo box. All those noted showed considerable freeboard when loaded.

All the tow-boats observed were stern wheel steamboats and some were pretty fair sized craft. The largest and fastest is the *King*, owned by the King company. Tows were usually of two loaded barges and a speed of three miles per hour was made while towing against the current. The stern wheel type is preferred because of its success in low water. The captain of one boat said that it drew 33 in., which was about as great a depth as could be counted upon in the low water of the summer months.

Barges are unloaded by shore derricks, some of which have steel and others wooden masts and booms. Where ladder dredges with screening equipment are used there is no shore plant for washing and screening

Installing an 18x36-in. jaw crusher at the Oliver King Sand and Lime Co.'s plant

and the material is loaded from the barge directly into railroad cars. The Cherokee Sand and Gravel Co. operates such a plant in addition to its washing plant.

Mention has been made of the large primary crushers employed. The Oliver King company was just installing a 36x18-in. Farrell jaw crusher when the plant was visited. For secondary crushers it has a No. 6 Allis-Chalmers gyratory and an 8x36-in. Universal jaw crusher. The last named is a special type of crusher made for crushing gravel. The Cherokee company has a No. 5 Gates type gyratory as a primary crusher and a No. 6 Allis-Chalmers McCully as a

Stockpiling with a crane at the Oliver King Sand and Lime Co.

secondary crusher. The Knoxville Sangravel Materials Co. has the largest crusher of all, a 36x48-in. Morris jaw crusher, and an Austin No. 2 gyratory as a secondary crusher.

At one time it was the practice to return the large pieces to the river, but it is said that the government objected to this so the installation of larger crushers became necessary. If this is so it was a good thing for the companies, since the crushed material now forms so large a part of the output.

Grizzlies on most of the plants are of the usual bar type, but the Sangravel company has a novelty in the shape of a traveling roller grizzly. This has been in use for three years and has been very satisfactory. The screens in two of the plants are Gilbert screens of Stephens-Adamson make. The Oliver King plant has cylindrical screens designed by Mr. King and built locally.

Storage is well arranged for and the Sangravel and Cherokee companies have well-designed storage plants with long conveyor belts to build the stockpile. The Oliver King Co. has recently adopted a method of storing that is unique in the writer's observation. The material from the bins is chuted to a pile on the ground and picked up in a bucket by a Bay City Industrial Works crane. The crane then moves up the track at the same time the boom is swinging and deposits the bucketful on a stockpile. It would appear to be slow, but Mr. King says that for the short distances in which his crane has to move it is much faster than loading into cars, moving the cars to position and then unloading them. He also believes it to be cheaper than handling into and out of storage with a conveyor belt.

Truck loaders of Barber-Greene make are largely used for loading out of storage. The Cherokee company depends upon them altogether for loading both railroad cars and trucks from its stockpiles.

There is one product that is practically a specialty of this region. This is sand for polishing and cutting marble. The big quarries use a great deal of it. Mr. King told the writer he estimated the consumption to be 12 cars daily throughout the year. Specifications call for a sand, all of which passes an 11-mesh screen with some restrictions as to fines. That which was examined appeared to be almost all around 20-mesh in size.

Small gravel, ⅝-in. to ⅜-in. finds a ready market as road dressing. It binds very well, possibly because of the unusual amount of crushed material it contains.

Sand and Gravel Production in Canada in 1925

THE production of sand and gravel in Canada during 1925 totaled 11,018,647 tons valued at $3,220,410, according to finally revised statistics just issued by the mining, metallurgical and chemical branch of the Dominion Bureau of Statistics at Ottawa. In 1924 the production was 11,603,500 tons worth $3,181,083. Sand and gravel produced by railway companies made up 38.2% of the total Canadian production.

Importation of sand and gravel into Canada during the year were recorded at 282,203 tons appraised at $184,000, while silica sand imported for the manufacture of glass and carborundum and for use in foundries amounted to 143,502 tons at $353,237. As compared with 1924, sand and gravel exported in 1925 decreased 16.5% to a total of 864,672 tons.

Capital employed, including purchase cost of pits, equipment, stock on hand, cash and collectable accounts, by the 435 operators in the sand and gravel industry amounted to $5,286,268. The total number of employes in this industry was reported at 1650, consisting of 98 salaried employes and 1552 wage earners. Salaries and wages paid reached the sum of $1,231,856. Fuel and electricity cost $158,645, of which $19,386 was paid for electric power. Primary power employed consisted of 106 units with a total manufacturers' rating of 5024 hp.

The data referring to capital actually employed, number of employes, salaries and wages paid and fuel costs do not include any statistics regarding the production by railway companies. Because of the varied nature of the operations of these companies it is not possible to obtain any data other than production figures.

PRODUCTION, IMPORTS AND EXPORTS OF SAND AND GRAVEL IN CANADA IN 1925

	Tons	Value
Production—		
Molding sand	57,656	$ 58,880
Building sand and sand for concrete, roadwork, etc.	2,557,623	755,289
Other sand (including blast, core and engine sands)	47,538	17,770
Sand and gravel for railway ballast	3,950,328	570,235
Sand and gravel for concrete, road building, etc.	3,955,166	1,626,834
Crushed gravel	450,336	201,402
	11,018,647	$3,220,410
Imports—		
Sand, silica for glass and carborundum manufacture, etc.	143,501	$353,237
Sand and gravel, n.o.p.	282,203	184,000
	425,704	$537,237

SAND AND GRAVEL INDUSTRY IN CANADA,* 1924 AND 1925

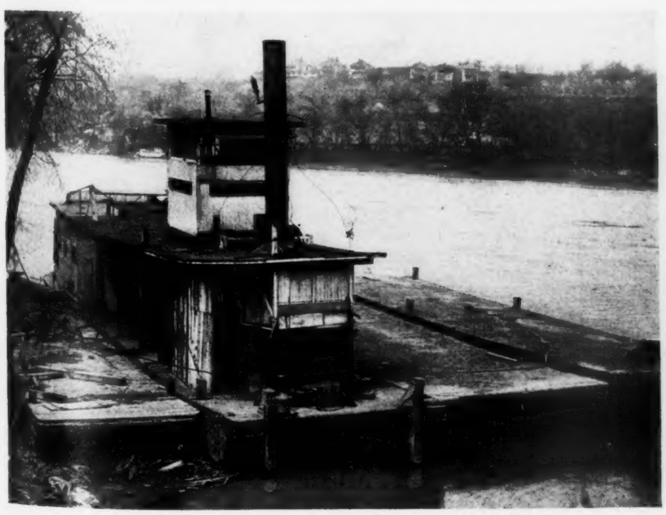
	1924	1925
Number of firms	558	622
Capital employed	$5,194,037	$5,286,268
Number of employes—		
On salary	93	98
On wages	834	1,552
Total	927	1,650
Salaries and wages—		
Salaries	$ 190,650	$ 209,512
Wages	658,091	1,022,344
Total	848,741	1,231,856
Cost of fuel and electricity	134,378	158,645
Selling value of sand and gravel†	2,441,914	2,601,970
Selling value of sand and gravel produced by railway companies	739,169	610,440
Total selling value of sand and gravel produced	3,181,083	3,220,410

*Except for the item of production, the data in this table refer to producers other than railway companies.

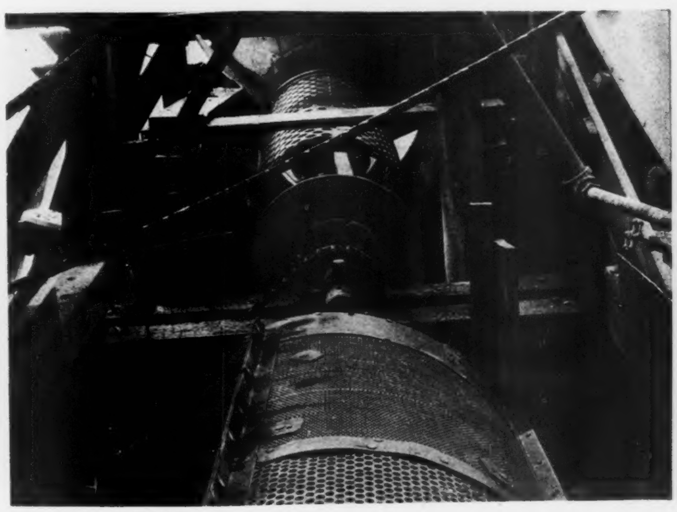
†Production by operators other than railway companies.

Phosphate Exports from Curacao

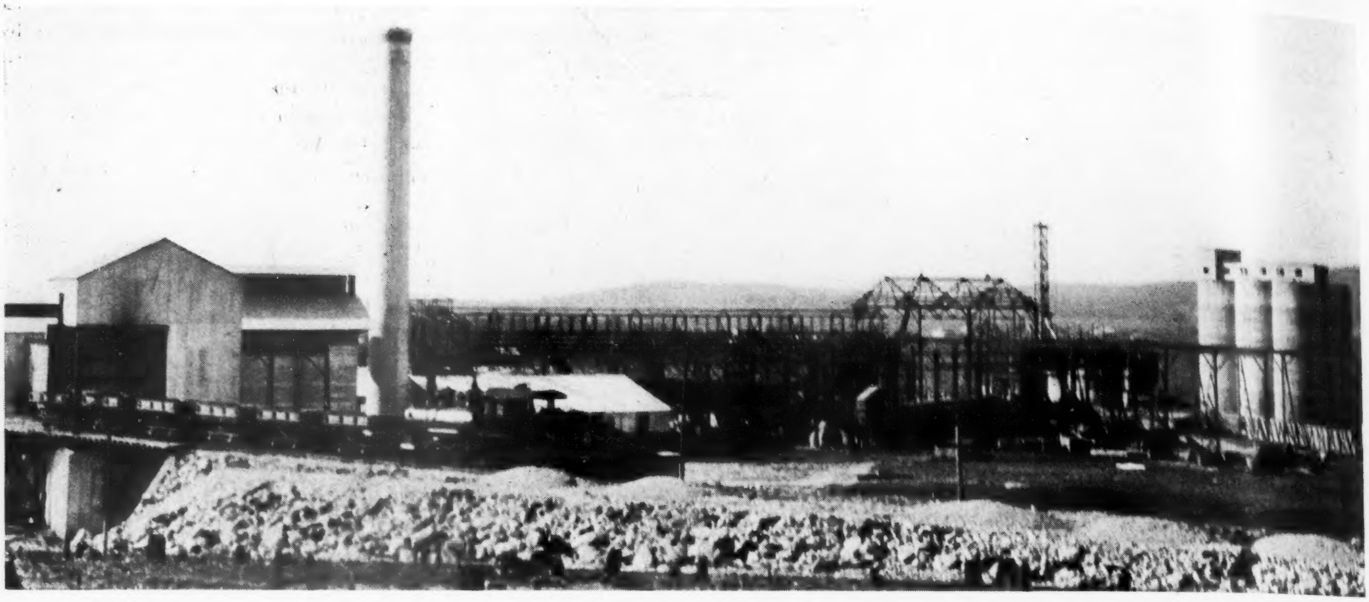
PHOSPHATE exports from Curacao to the United States increased from 2200 tons in 1925 to 2500 tons in 1926, according to Consul Thomas W. Voetter, Curacao, Dutch West Indies, writing in a recent issue of U. S. Commerce Reports.



Steam tow-boat and flush deck barges, Oliver King Sand and Lime Co.



Cylindrical screens installed at the Oliver King plant. They were designed by Mr. King and built locally



Cumberland Portland Cement Co. plant at Cowan, Tenn., which will go into production shortly

Future of Rock Products Industry in Tennessee and Carolinas' Looks Good

Rapid Development of the Cement Industry Seems Justified by Local Judgment—South Carolina Has No Limestone Deposits

By Edmund Shaw
Editor, Rock Products

THE cement situation in the southeastern states is interesting because so many plants are already producing in that area and more are expected to be in production before the end of another year. In Tennessee are the Clinchfield plant at Kingsport, and the Hermitage at Nashville. The offices of those companies, which have plants fairly near Chattanooga, are the Penn-Dixie, the Signal Mountain and the Warrior companies. In and near Birmingham, Ala., are the Atlas, Lehigh, Phoenix and International plants, with the National plant at Ragland, only a short distance away. In Georgia there is the Penn-Dixie plant at Clinchfield. Of the plants which may begin production within a year there is the plant of the Cumberland Portland Cement Co. at Cowan, Tenn., between Nashville and Chattanooga, which will be ready in about two months. The Florida Portland Cement Co.'s plant at Hooker's Point, near Tampa, Fla., is well on its way to completion and the Georgia Portland Cement Co.'s plant at Sandersville, Ga., is under construction. Work on the plant of the newly formed Volunteer Portland Cement Co. at Knoxville, Tenn., is expected to begin shortly. In addition to the production from new plants, the mills already producing will provide for an increased output, as several of them are adding, or have recently added, equipment for that purpose.

Who Is to Buy the Cement?

This looks like a lot of cement to be made in a comparatively small part of the country's area, in which there are no very large cities and where the countryside is somewhat sparsely settled. One of the things I wanted to find out when I started on this trip was—who is expected to buy all this cement and to what uses will it be put? I have asked the question of a number of people since coming here, and especially have asked the managers of producing plants, and plants which are being built, about the possibilities of an increased market. Of course none of these men would wish to be quoted directly, but the following is a summary of the information given me along with the result of some personal observation:

In the first place, it was pointed out to me, this southeastern area is growing in population and in producing power in a way it does not completely realize. The figures obtainable would seem to bear this out. The four big cities in this area are Atlanta, Birmingham, Chattanooga and Knoxville, and all are certainly gaining in population and doing a lot of building. I can see that from having visited each of them two or three times since 1920. Atlanta, according to one of its newspapers, is gaining about 25,000 inhabitants per year, a larger percentage of its population than Chicago can show with its 70,000 annual increase. Birmingham is said to grow at about the same rate. Knoxville had 75,000 people in 1920 and the latest census estimate gives it 134,000. Chattanooga is perhaps not quite so large, but it may equal it if it annexes some of its rapidly growing suburbs. Smaller towns are not growing so fast except in industrial sections. But in North Carolina, which is coming to be one of the leading industrial states, many towns having from 15,000 to 60,000 people, are gaining rapidly. The same is true of the western part of South Carolina, which is fast becoming industrialized. Such growth is enough in itself to account for a large increase in the use of building materials, among which cement is coming to be of the first importance.

Large Volume of Building

In addition to the requirements of an increased population for houses, business buildings, factories and the like, there is a more

than usual amount of building of public and semi-public work such as highways, bridges and hydro-electric plants. North Carolina has a fine system of hard surfaced highways, but South Carolina is only beginning to build them, the road map showing only a few short roads built out from the principal towns. One cement plant manager told me that he looked for Tennessee to build 800 miles of hard surface roads in the next year or two and for Georgia to build over 500 miles. The people here want good roads and are willing to pay for them. The gas tax in South Carolina is 5 cents a gallon and nobody complains about it. Many thousands of barrels of cement will go into highways in the near future. It may be mentioned that even the bituminous type of hard surfaced road used here requires cement, as it is laid on a concrete base.

Bridge building will consume much cement. This is written at Columbia, S. C., and at this place a very beautiful concrete bridge is being built across the Broad river to connect the city with the little towns of Brookland and Cayce and other points beyond. The present structure is a narrow and somewhat flimsy steel bridge, quite unsuited to modern traffic. There are many such bridges through the southeastern states that will be replaced by modern concrete bridges as fast as the financing can be arranged. This has been called the "age of bridges." It might be properly called the age of concrete bridges with reference to this particular section of the United States.

New Hydro-Electric Installations Use Large Quantities of Rock Products

As to hydro-electric installations, one of the largest is shortly to be built near Columbia. One of the engineers of the project recently explained in my presence some of the needs of the job. He thought that in the first six months they would want about 500,000 tons of crushed rock, for which a quarry may be opened, and he spoke of 100,000 tons of washed sand to be needed shortly. An enormous tonnage of rip-rap is also to be used. Such jobs mean a lot of cement and more than one project is at a point where it is fairly sure to go through. Fuel is scarce in the Carolinas, but water power is abundant and this alone is sufficient to attract and hold industry, as has been proven not only here but on the Pacific coast and in Italy.

Section Not "Over-Planted" is General Opinion

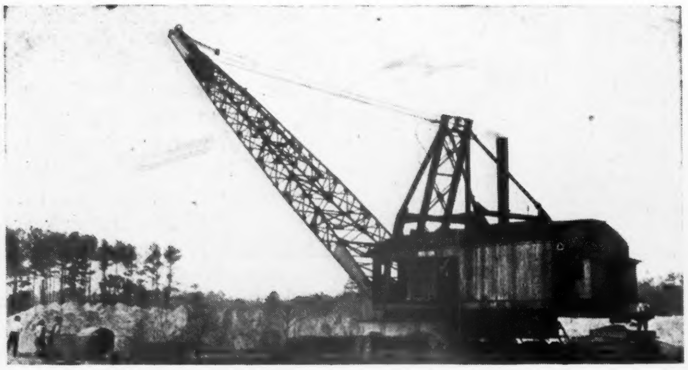
Everyone who has the real good of the country at heart knows that it is better, even for the consuming public, to have one plant steadily running and prospering rather than to have two plants fighting for a market which will support only one. It would be a bad thing for this or any other section of the country to become "over-planted" with cement mills. It was the writer's impression before coming down here that the southeast was approaching such a condition, but having seen the towns and having talked with conservative men who should know the situation, he feels that perhaps there is not so much danger of an overproduction of cement. At least the managers of plants producing and about to produce say there is nothing to worry about and they believe the markets of the locality will be able to absorb the production of new plants and the increased output of old plants. But they are equally certain that this would be a good time to stop building cement mills until the market puts a strain on the present production facilities.

Rock Products Possibilities in South Carolina

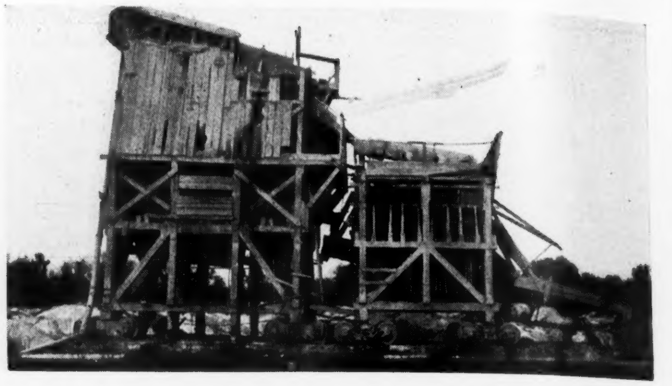
South Carolina lies about two-thirds in the coastal plain and one-third in the Piedmont region, the fall-line passing through Columbia, running about northeast and southwest. The coastal plain region has been famous for its cotton and tobacco, but since the relative decline of agriculture the growth in population and wealth is found in the western portion, where the Piedmont runs into the foothills of the Blue Ridge mountains. This region is attracting industries from the water power and labor that are available.

Dr. L. L. Smith, associate professor of geology at the university here, gave me some information about the rock products possibilities of the state. These are not so promising as in some other states for limestone and gypsum; the minerals of the most important of these industries are hardly to

Newly opened quarry of the Cumberland Portland Cement Co., Cowan, Tenn.



Dragline used with portable washing plant at a sand and gravel operation near Eastover, S. C.



Portable washing and screening plant of the Lawrence Stone and Gravel Co.

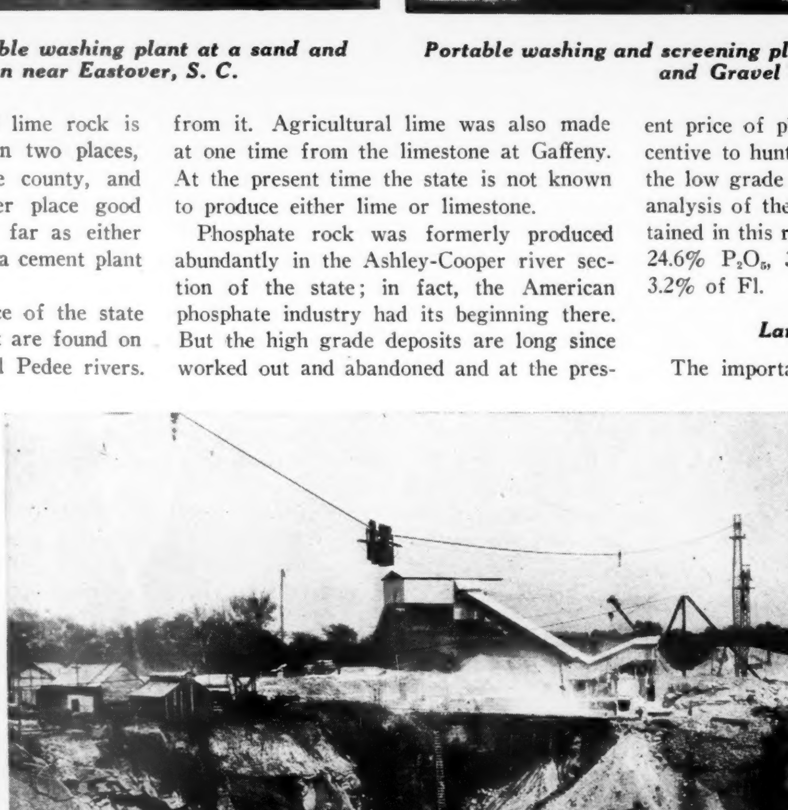
be found in its area. Hard lime rock is known to be exposed only in two places, near Gaffeny and in Oconee county, and there is no deposit in either place good enough or large enough (so far as either has been developed) to serve a cement plant or a lime plant.

The one large lime resource of the state is the beds of shell marl that are found on both banks of the Santee and Pedee rivers. These marls are old shell beds which have consolidated more or less and some of them are very high in lime. Analyses of 97% $CaCO_3$ have been made on some samples, but a more usual content is around 80%. In some places the lime content is low, falling to 52%. The thickness of these beds varies from 20 to 30 ft. and could probably be counted upon if they were to be worked. They are covered with an overburden of sandy clay 15 to 20 ft. thick, although not of that thickness everywhere.

Every state wants a cement plant of its own, for some reason, and the possibilities of this marl as cement raw material have been investigated although not very thoroughly. Dr. Smith thought the greatest obstacle to its use would be the distance from the right kind of clay. There is clay in abundance in the state, but none of it near the marl. The possibility of using the sandy clay overburden, at least in part, does not seem to have been considered.

This marl has been worked for agricultural limestone and in the old days some lime was burned from it. Agricultural lime was also made at one time from the limestone at Gaffeny. At the present time the state is not known to produce either lime or limestone.

Phosphate rock was formerly produced abundantly in the Ashley-Cooper river section of the state; in fact, the American phosphate industry had its beginning there. But the high grade deposits are long since worked out and abandoned and at the present price of phosphate rock there is no incentive to hunt for new deposits or to work the low grade material left. One published analysis of the phosphate rock formerly obtained in this region showed that it contained 24.6% P_2O_5, 39.4% CaO, 16.0% SiO_2 and 3.2% of Fl.



Weston and Brooker quarry at Cayce, near Columbia, S. C.

Large Granite Areas

The important rock products industry of the state is that of producing aggregate and road material. Crushed granite comes from perhaps a dozen quarries and gravel from as many plants. Granite, of course can be found almost anywhere in the Piedmont region, but gravel occurs only in the coastal plain and the best deposits are near the fall line. The origin of these gravels, according to Dr. Smith, is the quartz veins and dikes which cut through the granite. Where erosion has worn away and disintegrated the granite the quartz has remained and been carried toward the sea by the action of rains and by the rivers.

Unusual Gravel Operation

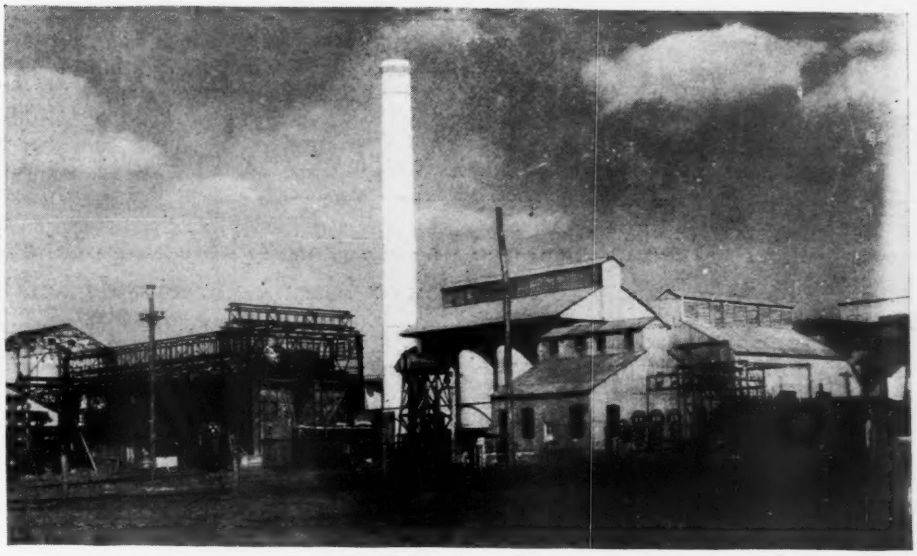
I visited only one gravel operation in the state, that of the Lawrence Stone and Gravel Co., about seven miles beyond Eastover. It is in a flat plain near the river and the gravel is covered with 10 to 12 ft. of overburden. This is stripped off with a dragline at night, and the same machine digs the sand and gravel in the daytime. It is a very large dragline to find in a gravel operation, a No.

260 Marion with a boom 110 ft. long. It can handle a 5-yd. bucket, but at the same time the plant was visited a 3½ Page bucket was being used.

The feature of this operation which most interested me was the washing plant, which is portable and runs on a double railroad track following the dragline. The plant contains gravity screens and a sand settling box and discharges its product directly into cars. Water for washing comes from two 6-in. Fairbanks-Morse pumps coupled on an 8-in. line, driven by two 37½-hp. oil engines of the same make. The capacity of this plant is much more than one would think it could be from seeing it. It has actually produced 20 cars of gravel and 15 cars of sand in a day's run. However, since the efficiency of a gravity screen is not great when it is overcrowded, much of the gravel has to be rescreened when careful sizing is required. The rescreeening plant is a somewhat similar device fed by a locomotive crane.

The use of a portable washing plant of this kind has been often discussed and sometimes tried—but without very encouraging results. The experience of this operation, however, would indicate that it works out under some conditions, for, the present plant being about worn out, a new portable plant is being built which will be of steel construction and carry modern vibrating screens and have modern sand settling devices. The directors of this company are interested in other sand and gravel operations, including one very large one, so their conclusion has been derived from experience with more than one type of plant.

Near Columbia are two of the largest crushed granite producers in the south, the Weston and Brooker Co. and the Palmetto Quarries Co. Each has an output of 1000 to 1500 tons daily and both have modern and well-equipped plants. Both will be described in forthcoming issues.



Another view of the Cumberland Portland Cement Co. mill at Cowan, Tenn., which will soon be adding its quota to Southern production

New Phosphate Deposits in Spain

SEVERAL years ago phosphate deposits were discovered in the northern section of the Sierra, in a place known as Prado Mayor which belongs to the municipal district of Mula. They form in layers which appear at the surface about midway up the hill. The phosphate is of sedimentary origin, similar to phosphates found in North Africa. The earth containing this phosphate is composed of rounded out green grains of queen chalk mixed with gray grains of phosphate of lime and calcite, cemented together with a loamy substance. The richness in tricalcium phosphate varies from 17 to 30%. The potash content is 5.50%, nitrogen 0.60%, vanadium 0.23%, and titanium 0.60%. According to Spanish geologists this is perhaps the only mineral of its kind in the world, as no other is known to exist with such large proportions of potash, nitrogen, vanadium, and titanium. Limestone is found merely in scratching that narrow band appearing on the surface, and everything leads to the belief that the mass of phosphate may be found directly under this band. It is calculated that there are more than 50,000,000 tons of workable mineral. These deposits were studied by a commission of engineers appointed by the government, and the reports were so favorable that these mines will no doubt attain a high degree of importance. Repeated tests made on a large scale have demonstrated the value of the product ground to a convenient form without it being necessary to transform it into superphosphate. There is another deposit of phosphorite in Logrosan (Caceres) which is being exploited by a foreign company, but the quantity handled is very small on account of the distance from the railroad. *Commercial Attache Chas. H. Cunningham, Madrid,* in Bulletin of Foreign and Domestic Commerce.

Recommendations for Standard Rock Dusting Practice Issued

RECOMMENDATIONS of the American Engineering Standards Committee for standard practice in rock-dusting coal mines have recently been published by the United States Bureau of Mines. Several members of the bureau served on this committee, whose recommendations are essentially in harmony with those of tentative specifications previously published by the bureau. As certain supplementary details are not included in the recommendations formulated by the American Engineering Standards Committee, that serial should be considered by coal-mine managements in conjunction with the committee's report now published, says the bureau.

The tentative specifications of this committee were published in ROCK PRODUCTS, March 7, 1925.

Prehistoric Flint Quarry Uncovered Near Dover, Tennessee

AN ancient flint quarry, where a prehistoric people made their swords and their plowshares, was uncovered near Dover, Tenn., recently by P. E. Cox, state archaeologist, accompanied by Dr. W. K. Moorehouse and two of his staff from Andover Academy, Andover, Mass.

The quarry, which covers about 150 acres, was discovered on the farm of Charles Brigham, four miles east of Dover, in Stewart county.

Hundreds of pits and tons of flint flakes were found by the investigators, indicating a life in Tennessee long before the American Indians came.

Flint implements from this quarry have been found, Mr. Cox said, at the headwaters of both the Tennessee and Cumberland rivers, indicating that the flints were carried for many hundreds of miles by the prehistoric natives.

No such quarry has ever before been discovered in the southern states. Similar quarries have been found at Flint Ridge, Ohio, but none south of the Ohio river before, Mr. Cox said.

There are some remains of fires at the stone quarry, Mr. Cox said, but not enough to indicate that people lived there. The stone quarry was buried under several feet of earth. Pits were found at intervals of about 20 feet. The area, which is about 150 acres, indicated that the quarries supplied a considerable population. This coupled with the fact that the flints were found as far as several hundred miles away from the spot, indicated that the quarry supplied a whole state or a large number of prehistoric peoples.—*Nashville Tennessean.*

This answers, in some degree, a recent inquiry of a subscriber as to the antiquity of the quarry industry.—THE EDITOR.

Lime Receives Prominence at Meeting of Nation's Chemists

Symposium on Lime at Richmond Meeting of the American Chemical Society an Education for Manufacturers and Chemical Industries Alike

IN this résumé of the papers presented before the division of industrial and engineering chemistry at the Richmond, Va., meeting of the American Chemical Society, April 13 and 14, only the high spots are touched upon. Some of the papers of more particular interest and value to lime manufacturers we will publish complete in later issues. Those who desire a complete publication of all the papers—and there should be at least one man in every lime plant who could profit from reading them—may obtain these in the May issue of *Industrial and Engineering Chemistry*, the official journal of the American Chemical Society.*

The Problem of the Lime Industry

By James R. Withrow
Chemical Engineering Department, Ohio State University, Columbus, Ohio

The purpose of this symposium is to call sharply to the attention of the lime manufacturer (1) that there is a chemical industry; (2) that the chemical industry is permanently and irrevocably interwoven with our industrial development; (3) that while many ways of meeting construction demands exist which may or may not affect the demand for lime, the construction business is after all a seasonal one, while the chemical industry on the whole knows no seasons; (4) that this chemical industry has innumerable variations in its nature and raw material demands; (5) that the lime industry or any other industry will be well repaid for the time and effort spent in studying the raw material needs of the chemical industry; (6) that the chemical industry cannot consume any old kind of lime; (7) that to get the business which should come to the producer of the lowest cost alkali, the lime maker must study his consumer's business, as every other chemical industry does, for the lime industry is a chemical industry.

It is also the purpose of this symposium to call sharply to the attention of the chemical industry and of chemical workers (1) that the lime industry is also a chemical industry—perhaps the oldest chemical industry; (2) that as a chemical industry it has all the problems and grief which make the life of the chemist and chemical engineer one long achievement in overcoming obstacles; (3) that therefore the producers of this most fundamental and lowest cost alkali —lime—must get all the chemical co-operation the chemical industries can give, but also such price support as will insure the maintenance of essential standards of raw material effectiveness.

Wise manufacturers in the chemical industry have long observed that theirs is essentially a service industry and not the mere furnishing of products. The only use for these products is service; when those to be served are in trouble from whatever cause, even though not connected with the chemical product, the condition is not healthy for our product.

In view of these facts, the chief purpose of this Lime Symposium will be to focus attention upon the problems of production in the lime industry.

Problem of the Lime Industry

Since no two limes are alike and even limes with practically identical chemical composition vary greatly in physical and other properties, require different handling in production, and behave differently in the hands of the consuming industries, the problem of the lime industry is not a simple one. Endless investigation will always be necessary with changing raw material and increasing demands for production, in addition to the normal engineering struggle toward perfection in production. The same situation will hold in every consuming industry, for a change in the quality of lime, either physical or chemical, may profoundly affect its value to the given industry.

There is a corresponding benefit to the lime industry in spite of these difficulties, for the very differences in the limes give opportunity for service to the most contradictory demands.

The problem of the lime industry, then, has many phases or subdivisions. The obviously endless complexities of these minor problems may be divided into the following categories:

(1) Problems of the market and of the economies.

(2) Problems of the chemistry which can be utilized to meet both the market and economic situation.

(3) Engineering which is made necessary by:
 (a) The chemistry utilized.
 (b) The market and economic situation.

Every industry struggles with a similar situation. One method of conquering this situation is the adoption of exacting specifications.

Problems of Market and Economies

The problems of the market center largely around the uses to which lime is put in the arts. This means two main markets—construction trades and the chemical industry.

The problem of the economies of the lime industry centers around the fact of locality and availability of limestone occurrence, transportation to market, the cost of fuel, and, above all, the handicap of abundant and cheap raw material with superficially similar product and the psychological nightmare that everybody thinks he can make lime and believes it should therefore cost nothing. As a matter of fact, scarcely two limestone deposits are alike by nature. Situation and relation to markets still further complicate the matter. Obviously, investment in quarry and plant will vary within several hundred per cent per unit of production as with the utilizing of any natural resource. The influence of such an investment situation profoundly affects the economies of the situation and the extent of service which can be rendered to the market.

Hydrated lime production is a problem-solution development which has greatly eased the general market problem. Utilization of spalls or their prevention are types of economic problems. The plasticity problem, rate of settling, activity, modification by burning conditions, are all essentially market problems in that they determine the serviceability of the product. Increased knowledge of the properties of lime is doing a world of service in solving market problems.

Problems of Chemistry

Chemistry furnishes two types of service: (1) the prevention of losses or wastage of a chemical nature which might occur during handling or manufacture; and (2) continuous control of manufacture for the furnishing of information as to the condition of the product at any stage of the process, thereby preventing heavy financial losses at unexpected times as well as the constant small drains or losses which eat up profits. In the lime industry there are problems where chemistry can be useful. The main chemical problem here is the complete burning of the lime in such a way as not to overburn it. While this burning operation has been largely turned over to engineering devices or methods, this very fact will probably be ultimately found to be connected

*Publication office, 706 Mills Bldg., Washington, D. C.

with the difference between success or failure in the application of many limes for specific uses. Even the solution of such a sensitive and elusive problem as plasticity will probably be eventually found to lie in a better chemical understanding of the changes which can or do occur during lime-burning.

Obviously, there are a host of chemical problems which arise in connection with the use of lime in the various industries. The ground has only been scratched in this regard. The consumer has too long insisted upon paying no attention to lime because he considered it a crude raw material, cheap, and having properties which could not be modified and which must be accepted as it came, with such regret or satisfaction as its use brought forth. Anyone familiar with engineering would realize that the adoption of any engineering device in such a business raises a series of chemical questions. Progress has been made in the absence of chemical consideration only because much ingenuity has enabled us to frankly ignore what should really have been studied. Some kind of result has been obtained and production maintained, in spite of the lack of proper answers to questions of a chemical nature.

This symposium will give an insight into the progress that has been made in the solution of various phases of the lime problem by a few of the thinkers and workers in this field. No one of them imagines that his job is completed. The problem of each, however, is not to produce any lime, but to produce the quality of lime which the market needs. The chemical industry constitutes an important and high-class portion of the market demand for lime.

The Consumer, the Market, the Lime Business and the Chemical Industry

By Charles Warner
Charles Warner Co., Wilmington, Del.

Today we are just beginning to appreciate that there are many physical variations in the different limes and their products due to differences in the structure of the original rock, in the methods of burning, and in the manner of its slaking or hydration, which will cause wide variations in its adaptability to the many industries now using it as a raw material. The same lime rock, sized and burned in two different ways, both methods being standard practices in various plants in this country, has shown a difference of 40% in the effectiveness of its use in a specific industry, and this in spite of the fact that the high-efficiency lime showed by chemical analysis 2% less available oxides.

In many industries lime has not received the study it should have to determine the particular characteristics needed for maximum benefit. This has probably been due to its cheapness, which has doubtless caused many of the consumers to frown upon its importance and to ignore its variations. It is hoped that this symposium will arouse the technical men and the executives in the lime industry and many of the chemical industries using lime to the importance of further investigation, and above all to the need of practical and friendly co-operation between the modern lime manufacturer with his technical staff and those responsible for improving the manufacture and control of practices in the industries using lime.

Modern Lime Manufacture

Lime manufacturing as perfected in some modern plants involves:

(1) Careful selection of the rock strata that appear in every limestone deposit in order to use for burning only such grades as are specifically suited for the known chemical, building, or agricultural uses for which the lime is to be sold.

(2) Proper sizing of the rock to give uniformity of burning in the particular type of kiln being used and under the particular method of burning employed.

(3) Maintenance of steady heat application for uniform and understood periods in order to produce that quality of burnt lime required for the particular trade, and of as nearly uniform quality as modern experience provides in plant control.

(4) Maintenance of those conditions for hydration which are found to produce the desired characteristics in each lime.

(5) Thorough and continuous chemical and physical control of all these steps by skilled laboratory supervision.

Lime manufacturing has become a highly specialized chemical industry, though many do not yet recognize this fact. The methods still pursued in many quarters where the highest grade of chemical limes should be manufactured, and the lack of understanding and specifications on the part of many users, give evidence of this.

Lime-burning plants, including raw material deposits, can be developed at a capital cost ranging from $1000 to $7000 per ton of daily output. This is a very wide variation, and yet this fact has such a large bearing upon the market situation and the consumer's problems, that it should be brought out in this general statement.

It has been only within a few years that a few of the lime manufacturers, inspired partly by the initial research efforts of the National Lime Association and some prominent consumers of lime, have endeavored to raise the quality and service requirements, in spite of the moderate yield on the capital required to construct a modern plant of large capacity. Such organizations can solve their business and financial problem only by a large production in order to take care of the extra cost of stone selection, storage service, and extended chemical and physical control of all operations. As an additional expense, the modern chemical lime enterprise must endeavor to work out its part of the thousands of combinations by the closest possible technical co-operation with the lime-using industries. This is scientific marketing in its best American form. When the technical men in the lime industry have learned the effect on the physical characteristics of the finished product, of the various changes that they can control in the selection and burning of rock, and the various methods of slacking or hydrating, they are in position to co-operate with men of similar experience and training in the consuming industry in working out specific applications. Such intelligent co-operation is now beginning to develop between producer and consumer, and it should be encouraged to the utmost.

Development of Specialties by Lime Plants

As the manufacture of special grades of chemical lime products develops, in order that they may have the maximum desirable characteristics for each of the refractories, glass-making, tanning, soap and sugar manufacture, water purification, and other processes too numerous to mention, lime plants will become specialists and operate for these distinct uses.

It is urged that purchasing departments acquire as complete a knowledge as possible of the limes available for any particular consumer's plant, and sufficiently clear specifications for economy and quality in the finished products to enable them to buy on economic standards and not on price standards. Almost all American industry is trending this way, and properly so.

Both the producers and users of lime should become acquainted as rapidly as possible with their particular requirements and the inherent possibilities in lime itself. When this has been accomplished in each industrial use, we shall have made a decided advance in the intelligent and economical use of lime so that reasonable continuation of high-class results can be secured.

Progress and Future Tendencies in the Lime Industry

By Oliver Bowles
Non-metallic Minerals Experiment Station, U.S. Bureau of Mines, New Brunswick, N. J.

[Dr. Bowles reviewed in some detail changes in quarry practice, underground mining developments, the increasing production of hydrated lime, more exacting specifications, the increasing knowledge of the properties of lime and the increasing utilization of fine materials, or small fragments of limestone. The following paragraphs are of special interest.]

Increased Kiln Efficiency

Calcination is the most important process in the manufacture of lime. Much progress has been made in overcoming the crudities of the early lime kilns. Increased kiln efficiency has been brought about in several ways, as follows:

Better Kiln Design—The shapes and sizes of kilns have been modified to accommodate a large tonnage of stone, and to give maximum draft with a minimum of waste heat; also coolers have been so designed that the heat of the burned lime is largely conserved.

Effective Insulation—The better types of modern kilns are so insulated that there is little heat loss through the shell.

Better Firing—The type of fuel to be used, the arrangement of fire boxes, the time and manner of firing, and methods of forced or induced draft, have been studied, and many improvements have been worked out.

Agents for Promoting Calcination—Both steam and carbon dioxide, introduced beneath the grates, are employed to control draft and temperature in the fuel bed. E. E. Berger, of this station, has recently completed experiments designed to test the value of steam as an aid in calcination. His results are described elsewhere in this symposium. The point is brought out that the advantage gained from steam is in many instances simply an increased draft, which could be accomplished just as well and at much lower cost with an air current. The employment of the Eldred process using carbon dioxide from the kilns seems to offer decided advantages over the steam jet method. The use of the Eldred process, and the employment of forced or induced draft would apparently permit the abandonment of many of the present expensive steam-boiler installations, amounting in some instances to the equivalent of several hundred horsepower. Thus a step has been made toward the attainment of a higher fuel efficiency. Much still remains to be done. The conviction is gaining ground that limestone calcination at its best is a highly technical process which will reach its highest development through the services of the physical chemist, the metallurgist, and the combustion engineer.

Bridging the Gap Between Research and Profits in the Lime Industry

By W. E. Carson
Riverton Lime Co., Riverton, Va.

Twenty-five or thirty years ago the lime industry was asleep, and its awakening has been due to the persistent efforts of such men as those of which the American Chemical Society is composed. It has been a matter of great interest to see the awakening of manufacturers to the idea that the burning of lime is not alone dependent on the five senses, but that other elements, such as intelligence, enter into it, and that the long-used statement that "lime is lime" is not accurate.

For about twenty years it was necessary to centralize our educational program on these embryo lime producers to get them to believe that their product should be developed as a manufacturing industry, and to put in better machinery, use better methods of manufacture, and acquire trade ethics.

That we succeeded, the lime industry itself today stands as testimony, but while we have made great strides we have not yet been able to drive home to a large number of lime manufacturers the last and most important step—the necessity of chemical control and of preparing their product to meet the chemical requirement of the process in which it is to be used.

A few excerpts from the minutes of some of these meetings may be of interest in showing the attitude that we had to meet in the early days. Going back to 1909, the following appears in the minutes:

Mr. Chairman—We are business men, and I cannot see why you should have taken up so much of our time this morning by having one of those engineers, or chemists, or whatever you might call them, to appear before us, as who wants to listen to such stuff as they get off. My father manufactured lime before me, and I'll bet he never heard such stuff as was pulled this morning. Let us quit this sort of talk, and attend to business at our meeting.

In 1910, the following appears:

Mr. Chairman—I wish you would see to it that no more of them highbrows appear before the Association; I don't know whether you pay these men for making speeches—if you do, you are just wasting the money of the Association—if you don't, you are wasting our time. What we want to do is to talk common sense and not about CO_2 and such stuff—who cares whether CO_2, CO_3 or CO_4 is in limestone or not—what we want to know is where we can buy our coal cheap, etc.

In 1911, Charles Warner offered a very able paper on "Combustion in Lime Kiln Practice." The following is taken from the discussion of his paper:

Mr. Chairman—I was astonished at Mr. Warner taking up the time of this Association with the paper that he offered, all full of scientific stuff; why, this is the sort of bull that is gotten off by those chemist chaps.

We all appreciate the good work you are doing, in bringing us manufacturers together, but why waste our time on such discussions? Chemistry is all right for college professors, but let me tell you, the quickest way to ruin business is to start experimenting on it. I know a man outside of St. Louis who went broke because he did not take the advice of his old foreman, but listened to these chemists, who said they could burn lime with gas. Now, everybody knows that you can't burn lime except with wood.

Since that time there has been a steady growth in the belief that scientific knowledge is a necessity in the manufacture of lime, but it is only in a limited number of plants that as yet scientific knowledge is being applied to the product itself. Lime manufacturers have spent large sums of money to develop the best fire-resistant brick that it is possible to use in their process; they have investigated what is the best coal to use; they have studied the use of rotary kilns, gas kilns and flame kilns; they have worked out the right size of stone to be used; they have employed mechanical experts to develop machinery to handle their product, and they have brought up their plants to a size and efficiency that makes the lime industry rank as one of the major industries.

All this has been done with the view of increasing output and decreasing cost of manufacture, resulting in the production and sale of lime at a very low price, often, unfortunately, without regard to quality. And this brings me to the main thought that I wish to emphasize—a thought which if it can be translated into accomplishment will be of more value to our industry and the more than one hundred and fifteen industries into which lime enters, or the six hundred different types of uses of lime, than any other one thing that can be done—namely, that each individual see to it that the company with which he is connected will not buy lime from any plant that does not employ a chemist, and that the purchase of this chemical commodity, lime, is not left entirely to the purchasing agent, whose sole thought is to chisel out a slightly lower price without considering the fact that limes differ as much as do human beings.

In every order for chemical lime the matter of analysis should enter, but a plasticity number should also be included. In commercial use chemical control is just as necessary as in the chemical industry. In one instance, failure to hydrate lime completely so that it was put on the market containing free lime caused great damage which would have been avoided had the lime plant been under chemical control. In admixtures with cement and cement mortars, quicklime is destructive, making an unsound concrete and mortar, and yet there are a large number of hydrates that carry sufficient free lime to make an unsound lime-cement mortar, and no lime plant, unless under chemical control, can be sure of the safety and soundness of its hydrate.

But, alas! chemists cost money, and laboratories are expensive, hence the lime manufacturer who competes on price only will not employ him, relying on the old adage that "lime is lime." Therefore, if we are to bridge the gap between research and profits in the lime business, the American Chemical Society must take a bold stand in condemning the purchase of lime for any purpose from any plant that is not willing to spend money through the employment of a chemist, who will watch the production and shipment of lime and see to it that the particular type of lime needed for a specific process is prepared. The lime industry needs just such encouragement and policing to make it a 100% industry.

Some Variables Affecting the Behavior of Limes Used in Causticizing

By J. V. N. Dorr and A. W. Bull
The Dorr Company, New York, N. Y.

In choosing lime for causticizing, it is necessary to consider its physical as well as its chemical properties, because after the causticizing reaction has been completed the caustic soda solution must be separated from the precipitated calcium carbonate, and the ease with which this can be done is dependent to some extent on the physical properties of the lime used.

Factors Influencing Settling Rate

Among the factors which are considered to have an influence on the settling rate of the calcium carbonate sludge after causticizing are the following:

I—Source of lime
- *A.* Chemical constitution
- *B.* Physical nature

II—Method of burning the lime
- *A.* Temperature
- *B.* Length of the burning period

III—Method of slaking the lime
- *A.* Amount of water used
- *B.* Temperature during slaking
- *C.* Degree of agitation during slaking
- *D.* Use of soda ash or caustic soda solutions for slaking

IV—Method of causticizing
- *A.* Period of agitation
- *B.* Violence of agitation

C. Temperature
D. Excess of lime or soda ash used.

V—Causticity and concentration of caustic desired

VI—Presence of impurities particularly when reburned lime is used

Summary

In the process of causticizing, the nature of the final precipitate can be greatly modified and its settling rate can be changed at least fiftyfold by changing the method of slaking and causticizing.

Under standard conditions high-calcium limes from widely different sources give quite comparable results.

The rate of reaction and the turbidity of the supernatant liquor are both changed by the same factors that influence settling rate, so that it is usually necessary to accept a compromise in which the three factors are all considered.

Before an intelligent estimate can be made of the size of chemical equipment required for a given causticizing plant, all the factors affecting the settling and reaction rate must be considered and fixed.

It has been shown that relative particle size may persist through the course of a chemical reaction between a solid and solution and that this may be of decided importance in determining the settling behavior of the final precipitate.

Analyses of Lime

By J. M. Porter
U. S. Bureau of Standards

Investigations made by the U. S. Bureau of Standards of many samples of lime and limestone fully convinced the investigators that other considerations than the chemical analyses affected the properties of limes.

The paper contains tables of analyses for SiO_2, Fe_2O_3, Al_2O_3, P_2O_5, MnO_2, As_2O_3, CaO, MgO, SO_3 and CO_2. None of the limes examined had appreciable amounts of arsenic (As_2O_3). All had some silica (SiO_2) and some alumina (Al_2O_3).

Problem of Rate of Soil Liming

By John A. Slipher
College of Agriculture, Ohio State University, Columbus, Ohio

A study of seventeen liming experiments on a wide range of soils in the United States reveals that fractional rates of liming are more efficient per unit of lime than are full applications. The superiority of light rates was found to hold true for rotations that included such crops as corn, wheat, oats, clovers, barley, timothy and alfalfa. With all crops except one of alfalfa, the first increment of lime gave relatively greater crop increase than did each additional increment. While the lime additions were arithmetic, the crop responses stood in geometric relation. Coincident with this relationship is a similar one with reference to change of soil reaction by lime. The first increment shifts the soil reaction (in terms of *p*H) more than does each increment supplied in multiple additions.

In general, the absolute responses of the cereals were lower than for legume crops, the latter including alfalfa, sweet clover, but more generally red clover. Corn surpassed the small grains at all rates of liming. This seems logical in view of the fact that corn generally follows immediately the legume in rotation and profits from the large supply of nitrogen acquired by the legume and by the favorable rate of nitrification fostered by the presence of the added lime. Wheat stands next in order among the cereals, followed at a somewhat lower level by oats. The wide range of soils involved in these summaries emphasizes the importance of the trends of returns as well as the absolute returns from lime.

In evaluating liming in terms of the efficiency per unit of lime, the magnitude of both the change in the reaction of the soil and the crop response are arguments for the lighter rates of application. The sensitivity of the crop as well as the intrinsic need of the soil for lime are extenuating conditions that modify the amount of the application. In general, it appears advisable to use lower rates of application than have been commonly advised in the past.

Lime in the Paper Industry

By P. A. Paulson
Appleton, Wis.

AMOUNT OF LIME USED ANNUALLY IN THE PAPER INDUSTRY

	Tons
Boiling rags, approximately only	18,750
Causticizing in soda mills	162,500
Causticizing in sulfate mills	150,000
Acid-making in sulfite mills	50,300
Total	381,550

It can easily be seen that there are possibilities for increasing the use of lime in the paper industry, and to realize them a closer contact between the manufacturer of lime and the paper maker is needed. The lime manufacturer should study paper-making so that he may be in a position to offer suggestions in matters that have to do with the chemicals used. In the paper industry the salesmen know more about the printing process than they do about paper-making. When any difficulties arise they are there to help solve them and to pass the information along to the paper mills, so that the changes can be made to bring about the desired results. In the writer's twenty-five or more years' experience in the paper industry he has not yet come into personal contact with any of the men who manufacture the lime he uses; all the business is done by correspondence.

In the manufacture of sulphite pulp it is an established fact that pulp cooked with a mixture of calcium and magnesium bisulphite is of much better quality than that cooked with pure calcium bisulphite; the fibers are softer, whiter and more easily bleached, and the yield is considerably greater. Yet a large number of the mills are using the tower system for preparing the acid. The same is true to a lesser degree in the rag-boiling process. Co-operation would not only promote the welfare of the paper and lime industries, but it would tend to conserve our natural resources and prevent a shortage of paper.

Extensive research work is being conducted in the paper industry, but it is chiefly with a view of obtaining a larger production — wider sheets of paper and higher speed. The choice as to what chemicals to use for resolving the new material into paper-making fibers is arbitrary.

When a new mill is built and the question as to what type of acid-making equipment to install arises, someone will advise putting in the tower system because limestone is cheaper than burned lime, not realizing that limestone weighs twice as much as lime and when the material has to be transported at some distance the freight costs as much as the limestone and the cost of handling is likewise higher. It is not very often considered that because magnesia is a stronger base the cooking process can be continued to its absolute completion without injury to the fibers, thereby reducing the amount of rejections or screenings and consequently increasing the yield.

It has been argued that the Europeans use the tower system. This is true, but there is no dolomite in Europe. At a recent meeting of the Verein der Zellstoff und Papier the question as to the best cooking liquor to use in sulphite mills was brought up and Professor Schalb stated that he was well aware that magnesium bisulphite was the best. "But," he said, "what are we Germans going to do? We have no magnesium."

The paper manufacturer seems to be too busy to keep up with the ever-increasing demand for paper to give this matter careful thought and study. There is a need for someone to arouse his interest and bring about a desire and decision to give this problem the attention it merits.

There is need of our combined effort to perpetuate the forests. At the present rate of consumption of wood for paper and other purposes, it will only be a matter of a few years until the forests are depleted, unless steps are taken to prevent it. This is well known but not seriously considered. In some European countries federal laws have been in force more than fifty years making it compulsory to plant two trees for every one that is cut down, and they have abundant supply to meet all their demands. What we need is public sentiment to bear on our legislators to enact similar laws, and we can all help.

No other single commodity has done so much for the advancement of civilization, education and comfort of mankind as has paper. By conserving our raw materials through the adoption of the most economical methods for resolving them into paper-making fibers and by perpetuating the growth of the forest, we shall be able to enjoy these blessings for years to come and incidentally promote the prosperity of the lime and paper

industries. To this end the manufacturers of lime can render a great deal of assistance.

Use of Lime in Water Softening and Water Purification

By Charles P. Hoover
Water Softening and Purification Works, Columbus, Ohio

The extensive use of lime in water softening has been held back by the limited results that could be obtained in reduction of hardness and because the softened water was not stable. Hardness is now further reduced by resorting to (1) the hot process, (2) excess lime treatment, (3) split treatment, (4) excess lime followed by carbonation, (5) the use of compounds of alumina, and (6) substitution of zeolite for soda ash to remove non-carbonate hardness. Stabilization may now be accomplished by recarbonation.

The advantages of the use of lime in water purification, its limitations, the progress that has been made in overcoming these limitations, and new practical applications are discussed.

It is shown that lime softening is exceptionally well adapted to the treatment of a badly polluted hard water, because coagulation is improved; organic matter, color, objectionable gases and iron are removed; and bacteria are killed, making it unnecessary to depend on chlorine if tastes and odors are feared, and thereby making it sometimes possible to produce a satisfactory potable water from a badly polluted water high in organic matter. It is a real adjunct to water purification because it increases the efficiency of sedimentation and filtration processes.

Recarbonization of Lime-Softened Water

A lime-softened water may now be cheaply and satisfactorily stabilized by recarbonizing it with carbon dioxide gas produced by burning coke, pulverized coal, oil or gas in a suitable furnace. After scrubbing and drying, the carbon dioxide gas is diffused into the water through small openings in a grid system located ahead of the filters. The carbon dioxide converts the normal carbonates, which are only slightly soluble, to bicarbonates, which are highly soluble and will, therefore, not be easily precipitated from the water. Enough carbon dioxide should be added so that the carbonated water will show just a faint trace of color when phenolphthalein is added to it.

Modern Applications of Lime Treatment

Two modern applications of lime treatment have recently been described by Waring.

Experience at Youngstown, Ohio—Several years ago the city of Youngstown instituted the excess lime treatment for the badly polluted Mahoning river water used as a source of supply at that plant. That the treatment has been a success is demonstrated by the experience of the last few years. The raw water pollution load at Youngstown is probably the greatest of any water treatment plant in the country. The yearly average B. coli index exceeds 20,000 per 100 cc. and it is not possible to use chlorine at this plant because of interference by phenol-bearing wastes. The final effluent during the past year has not shown a single positive presumptive B. coli test in any of the five 10-cc. portions tested daily.

Experience at Ironton, Ohio—Following the unsuccessful attempt at Ironton to relieve the bacterial load in the Ohio river at that point, a change of treatment was made beginning in December, 1925. The experience of Youngstown has been made use of at Ironton in the following schedule: The plant has double coagulation facilities; accordingly, lime was applied to a primary basin in an amount to produce causticity, therefore sterilizing the supply. Alum was applied at the secondary basin to coagulate the turbid Ohio river water. It was noted that considerable alum was required if the influent water to the filters was to be kept in a condition to prevent carbonate scale forming on the sand grains as a result of the excess lime used. In order to economize on alum, the pH value of the water is being reduced by the use of carbon-dioxide gas applied at the mixing chamber of the secondary basin. A saving of more than two grains of alum per gallon seems to be promised and the water coming to the filters contains no monocarbonate alkalinity that would encrust filters or piping beyond the plant. By means of the practice above related it will be possible to produce excellent filtered water without the use of any chlorine; without increasing the cost of the water treatment over previous practice; and having as reserve processes, or factors of safety in the treatment, both the coagulation in the secondary basin and the rapid sand filtration.

Experience at Columbus, Ohio—At the Columbus plant it is customary to omit the chlorine treatment during flood periods when the organic matter is high and the water has an unpleasant taste or odor, and to substitute the excess lime treatment, about 20 p.p.m. caustic alkalinity being carried in the filtered water. This amount of caustic alkalinity is not noticeable to the consumer.

Softening a Hard Well-Water Supply—One city in Ohio is now building a water-softening plant to soften a hard well-water supply. The water contains much objectionable iron which will also be removed in the softening process. This plant will be unique in that the softened water will not be filtered, and no after-troubles from deposits in the distribution system are anticipated because it is expected that the softened settled water will be sparkling clear and it will be carbonated, thus eliminating the possibility of incrustation in the mains.

The softening chemicals will be agitated with the water for one hour and a settling period of 24 hours will be allowed, with velocity through the settling basins of less than 7 ft. per hour.

On account of its low cost of construction, this type of plant, made available for municipal water softening on account of the successful development of recarbonation, should prove attractive to communities wanting to soften and improve the quality of their already clear but hard water.

Use of Lime in Butter-Making

By O. R. Overman
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One of the troublesome problems arising with the development of butter-making into an extensive industry based on scientific and economic principles has been the handling of sour cream, as experience has shown that butter made from cream of high acidity develops an unpleasant flavor upon standing. This problem led to a study of the use of alkaline substances for the reduction of the acidity of the cream and the development of methods by which lime is satisfactorily used for this purpose.

The most important of the alkaline substances which have been used are sodium carbonate, sodium bicarbonate, sal soda, calcium carbonate, calcium oxide, calcium hydroxide, magnesium oxide, and magnesium hydroxide. The tendency in the United States has been to favor the use of the calcium or magnesium limes, while the British Empire uses chiefly the sodium compounds. Quicklime was the first of the lime neutralizers to be used in the United States. However, because of a lack of uniformity in the product and because of the care and labor needed to prepare milk of lime from commercial quicklime, dry hydrated lime has, in the past few years, almost wholly replaced quicklime.

Methods of Using Lime

Hydrated lime is used in suspension in water. The suspension is made of convenient strength—for example, 2 lb. of hydrated lime in 1 gal. of the suspension. The use of this suspension depends upon the fact that as the molecular weight of the dibasic hydrated lime is 74 and all of the monobasic lactic acid is 90, 37 lb. of dry hydrated lime will neutralize 90 lb. of lactic acid. That is, for the neutralization of 0.01% of lactic acid in 100 lb. of cream, 0.00411 lb. of hydrated lime, or 0.01644 pint of the mix of the strength indicated above will be required. However, it has been shown by Hunziker and his co-workers that when a lime mix is used for the reduction of the acidity in cream, a portion of the lime, ranging usually from 16 to 20%, does not react with the lactic acid.

The reduction in the neutralizing strength of the lime mix may be compensated for in one of two ways: (1) About 20% more dry hydrated lime is used in the mix, or, instead of the 2 lb. per gal. of mix required theoretically for the reduction indicated above, the actual proportions are 2.4 lb. of lime in 1 gal. of the mix. (2) A lime with about 20% greater neutralizing strength than pure, dry hydrated calcium lime is selected. Such limes are the magnesium limes containing 35 to 50% of magnesium oxide. They have on the average from 16 to 20% greater neutralizing strength than an equal weight of the pure calcium lime. If such lime is used the mix may be made as originally indicated—2 lb. of the magnesium lime in 1 gal. of the mix.

Numerous experiments under practical factory conditions have shown that either of these two mixes will give satisfactory reduction of the acidity of sour cream. Some creamery operators use pure calcium lime.

Others use magnesium lime. Each group claims that better results are obtained with the type of lime it is using than with that used by the other group. Thus the relative merits of the two types of lime for the purpose under consideration are open for further study.

Present Status of Problem

The use of alkaline substances for the purpose of reducing the acidity of sour cream which was to be used for butter-making was at first opposed by public health and food inspection officials. The objections seemed to be based largely on the mistaken ideas that the purpose of neutralization was to make possible the use of a product unfit for food in the manufacture of a food, and that the alkaline substances used should be considered as food adulterants. With the growth of a better understanding of the real purposes of neutralization, these objections have largely disappeared. The development of the practice of neutralization has made possible the profitable manufacture of millions of pounds of butter, and—a fact which is of especial importance during the present agricultural depression—has assisted in providing a stabilized market at fair prices for a farm product which is important in all sections of our country.

Lime Problems in the Beet Sugar Industry

By R. W. Shafor
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The fundamental factors entering into the rate of decomposition of limestone lumps in kilns of the shaft type are discussed with emphasis on the transfer of heat. The experiments indicate that decomposition rates are controlled primarily by the rate of heat conduction through the calcium oxide layer on the surface of the decomposing lump.

The relationship between the factors involved in the process of transferring heat by conduction may be expressed algebraically by the equation

$$H = \frac{K\,A\,(t_1 - t_2)\,T}{D}$$

where

H = amount of heat transported
A = mean area of path traveled
D = mean length of path traveled
t_1 = temperature at hot end of path
t_2 = temperature at cooler end of path
T = time employed
K = coefficient of heat transfer

The experiments showed definitely that the shape of the unburned core was cubical, with the corners and edges only slightly rounded and with a slight tendency towards pitting on the faces.

The results of the experiments thus far completed indicate that the time required to decompose a given size of cube of this stone is directly proportional to the factor $(t_1 - t_2)$, the deviation being less than $\pm 15\%$. They further indicate that the time required for decomposing cubes of various sizes (2, 3 and 4 in. on the edge), when employing a constant temperature difference $(t_1 - t_2)$, is directly proportional to the square of the edge (or the surface area of the cubes). Thus, if a 2-in. (5-cm.) cube required 4 hours for decomposition, a 3-in. (7.6-cm.) cube would need 9 hours under the same conditions of temperature and carbon dioxide concentration. Here, again, the deviation was less than $\pm 15\%$.

The application of these conclusions to the operation of the 27 kilns employed in that branch of the industry with which the writer is associated has resulted in increased kiln capacity and a general reduction in coke consumption. One kiln, into which stone varying from 1 to 2.5 in. in size was charged for a period of 100 days during the last year, consumed less than 7.5% coke on rock as compared with more than 10% during like periods in previous years with stone varying from 4 to 8 in., the daily capacity being maintained approximately constant during all periods.

Grindability of Lime

The factors entering into the problem of producing a lime powder with suitable area remain untouched in a research way, although an investigation is planned for the near future. That a problem exists is evidenced by commercial experience wherein considerable variations in the "grindability" of the lime are encountered. The Raymond mill, with the usual closed-circuit air-classification arrangement, is employed for grinding in all cases and the maximum output per unit of equipment at the different factories varies as much as $\pm 50\%$ when producing powders of equal specific surface. It would appear at this time that grindability may be a function of either the source of raw material or kiln manipulation, or possibly of both, with the raw material exerting the greatest influence.

Role of Lime in Tanning

By George D. McLaughlin
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The object of the tanner is to remove completely both hair and epidermis, as well as the flesh or adipose tissue, and at the same time to dissolve or destroy the least amount of the collagen which composes the corium or leather-making substance. This is termed the "unhairing" process.

Most unhairing is accomplished with an alkali, either alone or mixed with sodium or arsenic sulphide. This alkali is a saturated solution of calcium hydroxide, although any soluble alkali will bring about unhairing.

Advantages of Lime Over Other Alkalies

Lime is favored not merely because of its cheapness. It has a limited solubility, and a saturated lime solution has a pH value of about 12.5. Therefore, the tanner may make up a vat full of lime solution and add an excess of undissolved lime, knowing that the solution's alkalinity cannot exceed pH 12.5 (at constant temperature) and that as lime is removed by the skins from the solution the excess lime will dissolve and maintain saturation. In other words, he has a practically automatic, foolproof process. Lime does not digest the collagenous material of the skin so greatly as do sodium and potassium hydroxides. Lime saponifies a portion of the fat in the skin. A lime soap is of a curdy nature, holding little water. It is important that the fat in the hair follicle be partially saponified so that the alkaline solution may freely penetrate the follicle and digest the keratinous material holding the hair. The curdy nature of the lime soap formed permits this penetration better than the jelly-like sodium or potassium soaps that result when these alkalies are used.

Lime Standards

In view of our lack of fundamental knowledge of skin proteins and their behavior toward electrolytes, it is difficult to lay down strict standards or specifications for lime quality for unhairing. It cannot be doubted, however, that a high CaO content is desirable, that even a small amount of iron is objectionable, that high magnesium content is either harmful or wasteful (since it seems practically inert in respect to unhairing), and that the lime should have a high "suspension factor"—that is, the excess undissolved lime added to a lime vat should settle downwards slowly.

Lime in the Treatment of Pea Cannery Wastes

By L. F. Warrick
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Methods for satisfactorily and economically disposing of cannery wastes in the prevention of nuisances and objectionable stream pollution have been sought by canners, chemists and sanitary engineers for a number of years. Those developed have been but partially successful or only of local application. The problems presented by the untreated wastes having become more acute with industrial expansion, in several states, considerable effort has been recently directed toward their solution.

Conclusions

1. The oxygen demand of pea cannery wastes can be reduced approximately 75% by screening and tank treatment with the application of 7¼ lb. of lime and 3¼ lb. of ferrous sulphate per 1000 gal.

2. Prompt removal of the chemically precipitated organic matter is desirable, since a portion goes into solution when allowed to accumulate in the tank. The oxygen demand reduction averaged only 34% under such conditions.

3. The sludge can be readily removed from the tank by means of a motor-driven diaphragm pump, and it can be rapidly dried on sludge beds. Analysis indicates a fertilizer value estimated at $3.50 per ton.

4. A further reduction in the residual

oxygen demand of the tank effluent can be accomplished by aeration, preliminary tests indicating as much as 50%.

5. Chemical treatment of pea cannery wastes without removal of the coagulated organic solids prior to mixing with municipal sewage does not materially lighten the burden imposed by such wastes on city sewage disposal plants.

6. The treatment will materially reduce objectionable stream pollution and prevent local nuisances often caused by untreated pea cannery wastes.

7. The estimated cost of waste treatment for a two-line cannery is $13 to $15 per day of capacity operation.

An X-Ray Study of Limes Having Different Plasticities

By Marie Farnsworth
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Marble and precipitated calcium carbonate are burned in air at 1800 deg., 2000 deg. and 2200 deg. F., and marble in a vacuum furnace at temperatures from 1200 deg. to 2400 deg. F. in steps of 200 deg. F. The plasticities of the hydrates of all these samples are measured and x-ray powder photographs of the oxides and hydrates taken. The samples burned in a vacuum are found to be more plastic than the samples burned in air. The CaO samples which give a plastic hydrate give a face-centered cubic pattern with unit edge 4.79A; the plastic hydrates give a hexagonal pattern with an axial ratio 1.40. The patterns of the less plastic samples are complicated by additional lines corresponding, if CaO films, to strong lines of the $Ca(OH)_2$ and $CaCO_3$ films, and if $Ca(OH)_2$ films, to strong lines on the $CaCO_3$ film. In every case the intensity of these extra lines can be taken as a direct measure of the plasticity of the sample; these lines are the same for samples burned at high and low temperatures, but for samples burned at the higher temperatures the intensity is less. Experiments were not carried out with overburned samples.

It is interesting to speculate as to whether or not the $Ca(OH)_2$ and $CaCO_3$ are the cause of the decrease in plasticity of the lime or simply an accompanying phenomenon. It is hard to see why $Ca(OH)_2$ present in lime should decrease the plasticity when it is all converted into $Ca(OH)_2$ before the plasticity is tested. However, the $Ca(OH)_2$ already present might act as centers of crystallization and thus give rise to larger crystals which would be less plastic. Since only $Ca(OH)_2$, and not $CaCO_3$, is present in appreciable amount in the more plastic air-burned samples, it may be only the $CaCO_3$ present which causes a decrease in plasticity. It is easy to see how $CaCO_3$ present in fairly large amount would decrease the plasticity by decreasing the amount of oxide present. By this it is not meant that a simple admixture of calcium carbonate would materially decrease the plasticity, but if the calcium carbonate coated some of the grains of oxide and slowed down the rate of hydration, the plasticity would be decreased. X-ray photographs of commercial samples show that calcium carbonate is always present in samples of low plasticity.

In the application of x-rays to lime plasticity we have a possible application to factory control. An x-ray photograph could be taken for each run and compared with a standard film for a sample of high plasticity. Extra lines would indicate a decrease in plasticity, and the intensity of these extra lines would be a direct measure of this decrease. The presence of $Ca(OH)_2$ and $CaCO_3$ offers no explanation of the low plasticity of overburned lime, but here the additional complication of sintering enters. Owing to the lack of a suitable furnace, no tests were made with overburned lime.

Effect of Particle Size on the Hydration of Lime

By F. W. Adams
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Samples of an eastern high-calcium lump lime with average diameter of particles varying between 10.0 and 0.1255 mm. were hydrated in an experimental apparatus to produce dry hydrates. After ripening, the hydrates were tested for moisture content, rate of reaction with hydrochloric acid, rate of settling, plasticity, and putty volume.

It is shown that the size of hydrate particles decreases with the diameter of the quicklime particles from which produced; a more reactive hydrate with lower settling rate is obtained from a finely ground quicklime.

In the range studied, for all sizes of quicklime particle of 5.0 mm. or below a satisfactory plasticity to classify the product as a finishing hydrate is attained, the values running between 265 and 386. A 10.0-mm. diameter particle yields an inferior hydrate of plasticity 147. Putty volumes vary between 137 and 180 cc. from 100 grams of hydrate, following the variations in plasticity.

To produce a satisfactory finishing hydrate a plasticity well over 200 is desirable. It will be seen from Table I that with a particle diameter of quicklime of 10 mm., the low plasticity renders the hydrate unsuitable as a finishing lime. In all the other runs a plasticity figure of over 265 was obtained, although the plasticity figure apparently bears no direct relation to the particle size of the quicklime from which made (Fig. 5). The higher plasticities occur at a particle size between 0.252 and 1.24 mm. diameter. As might be expected, putty volume follows plasticity, showing that increase in the latter is largely due to the increased water-carrying capacity of the hydrate. The two runs on the smaller sizes of particles, although yielding satisfactory finishing hydrates, do not attain the highest plasticity figures. It is evident that a high plasticity is not the result entirely of fineness of particle, but that there is undoubtedly a distribution of particle size in the dry hydrate which after soaking produces a putty of maximum plasticity. Thus hydrate *B* has about twice the percentage of particles of reaction time greater than 0.07 minutes that hydrate *J* possesses; moreover, its finest particles are much coarser than those in run *J*, as shown by the relative distances settled in 15 minutes. Nevertheless, the plasticity of a putty from hydrate *B* is 312, compared with a similar figure of 265 for hydrate *J*.

Conclusion

It has been found that in the hydration of a high-calcium lime the size of hydrate particles may be decreased by decreasing the diameter of the quicklime particles. Thus, a finely ground quicklime will yield a more reactive hydrate, possessing a lower settling rate. While a quicklime particle of 10 mm. average diameter yields a hydrate, with the low plasticity figure of 147, indicating an inferior hydrate, by reducing the size of quicklime particle to 5.0 mm. and below, the product may be classified as a finishing hydrate, plasticity values running between 265 and 386. The putty volume is found generally to follow the plasticity figure, varying between 137 and 180 cc. from 100 grams of hydrate.

TABLE I. EFFECT OF PARTICLE SIZE ON HYDRATION OF LIME

Run	Av. Diameter of Quicklime Particles Mm.	Moisture in Hydrate Per cent	90% Reaction Time Minutes	Distance Settled in 15 Min. Cm.	Plasticity	Putty from 100 Grams Hydrate Cc.
A	10.00	5.20	0.495	72.8	147	137
B	5.00	1.21	0.416	54.0	312	175
C	2.49	2.40	0.269	56.2	265	160
D	1.242	—0.21*	0.332	59.2	338	172
E	0.625	0.76	0.149	35.7	370	171
F	0.356	1.29	0.132	38.2	279	164
G	0.252	0.92	0.110	45.0	386	180
H	0.1775	2.99	0.097	41.2	272	155
J	0.1255	5.36	0.072	34.0	265	156

*Indicates 0.21% of free CaO in hydrate.

High-Temperature Whitewash

By Edwin P. Arthur, W. B. Mitchener, and James R. Withrow
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Application of whitewash to the clay work of industrial furnaces has not been a general practice. Whitewash, however, improves appearances and facilitates cleaning. The diffusion of light from the white surfaces materially aids in illuminating dark corners. Whitewash on the ports and flues to the regenerators reduces the infiltration of cold

air. Surface temperature of some types of furnaces may approach 350-400 deg. F. and higher.

Recommended Wash

Prepare a thin slurry by stirring finely ground lime into 5 gal. of water. Slowly add, with stirring, 5 lb. of salt, 5 lb. of plaster of paris and ½ pt. silicate soda. Apply immediately with a paint brush to brickwork. Addition of the silicate too quickly or in excess will cause the slurry to become thick and useless as a paint.

Such a wash was made and applied to the side walls and ports of an 800-ton regenerative glass furnace with excellent results. It was found much more desirable to apply two thin coats rather than one single heavy coat. The amount of wash required depends on the character of the clay surfaces.

Burnt Lime and Raw Limestone in the Basic Open-Hearth Process

By C. H. Herty, Jr.
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The use of burnt lime in the open-hearth furnace has the advantage of decreasing the heat period. Its use, however, is somewhat restricted to low hot-metal charges and by an economic balance between the following factors: Speed of heat, yield of iron, cost of pig iron and scrap, cost of burnt lime and limestone, and depreciation of an open-hearth furnace using a high hot-metal and a low hot-metal charge. The qualities of the burnt lime and limestone are of prime importance in the open hearth. Sulphur, silica, magnesia, and carbon dioxide should be kept as low as possible in burnt lime, and all these, except carbon dioxide, should be lower in limestone than in burnt lime.

Relative Prices of Raw Materials

The relative prices of scrap and pig iron also enter into the use of burnt lime, and the operator of an open hearth must take into account the time of the heat, the relative prices of raw material, and the depreciation on the furnace using different processes. The proportion of pig iron and scrap in the open-hearth charge is generally controlled by these variables, especially when using only one kind of flux. When heats charged with limestone and with burnt lime are compared, it is necessary to take into account the relative prices of the two, and this adds another factor to the economic balance. In general, therefore, the use of burnt lime is restricted to a fairly low percentage of hot metal in the charge and the economic use of burnt lime or limestone is affected by a number of variables, as already shown.

Quality of Burnt Lime and Limestone

The quality of the burnt lime and limestone is of considerable importance in that the composition of the open-hearth slag is one of the controlling factors in the quality of the steel made. Burnt lime should be reasonably low in sulphur (preferably under 0.05% and not over 0.10%), low in silica (approximately 2% or under), low in magnesia, and as low as possible in carbon dioxide. Lower contents of these impurities—except, of course, carbon dioxide—are desired in limestone, as the lime content is lower here than in burnt lime.

Effect of Steam on the Decomposition of Limestone

By E. E. Berger
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The rate of calcination of limestone in equal currents of air, steam, and helium was determined at increasing constant temperatures from 600 to 1000 deg. C. The calcination rate was slightly different in each gas, but this variation is explained by the effect of the physical properties of each gas on the transfer of heat to the limestone, and not to any chemical or catalytic effect which the gases might have on the limestone during the calcination process. It is shown that the differences in physical properties of the gas entering the lime kiln would not be changed sufficiently by the addition of a small quantity of steam to have any appreciable effect on the calcination process.

The first appreciable loss of carbon dioxide from a high-calcium stone occurred at one hour's heating at 600 deg. C.

The limestone was calcined at a slightly faster rate in a current of steam than in a current of air, but this was due to the effect of the characteristic physical properties of each gas in transferring heat to the sample, and not to any chemical or catalytic effect which either gas had on the limestone during the process of calcination. It is pointed out that these physical characteristics would not affect the rate of calcination in the lime kiln.

Effect of Steam on Combustion

The effect of steam in the lime kiln is not limited to its possible effect on the process of calcination; its chief function is to control conditions in the fuel bed. Carbon dioxide contained in the waste flue gas is also used to control conditions in the fuel bed, its action being quite similar to that of steam. A study has been made of the action of both steam and carbon dioxide in order to determine as far as possible their relative merits.

Steam has at least two and sometimes three distinct functions in controlling combustion conditions:

1. It may prevent packing of a low-grade coal so it can be made to burn almost as efficiently as the better grades.

2. It lowers the temperature in the fuel bed so that the utilization of a forced or induced draft does not produce the excessive temperature in the fuel bed which effects the clinkering of ash and destruction of grates. This action is brought about primarily by the large amount of heat which is absorbed by the endothermic reaction between steam or carbon dioxide and the incandescent carbon in the fuel bed.

3. It lengthens the flame, thus producing a more uniform temperature in the kiln and, as a result, a better grade of lime. The partial reduction of steam or carbon dioxide increases the percentage of combustible gases over the fuel bed. The secondary oxidation of these gases by the air which must be admitted over the fuel bed produces the long flame which is so effective in producing the mild, uniform temperature much desired in the burning zone of a lime kiln.

[This paper will be published in full in a subsequent issue.—Editor.]

Rotary Kilns vs. Shaft Kilns for Lime-Burning

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The cost of a rotary-kiln lime plant, including the crusher, kiln, cooler, motors, and building, but exclusive of arrangements for packing and loading, will amount to from $1250 to $2000 per ton of lime capacity, depending on fuel employed, etc. The cost of a modern grate-fired shaft-kiln plant, inclusive of incline and hoist but exclusive of packing building, will range from $1000 to $1500 per ton of lime capacity for first-class equipment. A waste-heat boiler plant, if desired, will probably add from 50 to 75% to the cost of a rotary-kiln lime plant, depending on the equipment selected.

It will be seen that the first cost of a rotary-kiln plant is from 25 to 35% greater than that of a grate-fired shaft kiln of similar capacity.

Where induced or forced draft is not included in the shaft kiln operation, the power required to operate is confined to that necessary to hoist stone to the top of the kiln. This is, of course, practically negligible—say, 0.25 kilowatt-hour per ton of lime burned.

The power required to operate the kiln per ton of lime produced is about as follows:

	Kilowatt Hours
To revolve kiln, feeder, etc.	3.2
To revolve cooler	2.0
To elevate stone, operate producer, etc.	1.0
Total	6.2

Where pulverized coal is employed to heat the kiln, about 6 kilowatt-hours are needed.

The dust loss from the rotary kiln is appreciable. It probably amounts to from 1 to 3% of the limestone fed into the kiln, depending on the character of the stone, etc. If this is likely to be a nuisance in the community, as where the lime plant is located near a town, it may be necessary to collect this dust by means of a Cottrell precipitator, washer, or some other device such as is used in the cement industry and at one or two lime plants.

Conclusions

The rotary kiln is best suited to burning lime: (1) where run-of-kiln lime will meet the requirements of the market; (2) where quarry spalls, highly crystalline, and very

soft limestones, shells, marl, etc., are to be burned; (3) for large outputs; (4) where operation is continuous; (5) where labor is high; (6) where fuel is cheap, where oil is obtainable as a fuel, or where pulverized coal can be used; and (7) where waste-heat boilers can be installed and the surplus power so obtained employed to advantage in other operations.

The shaft kiln is preferable: (1) where it is advisable to select the lime in order to secure a product that will meet the most desirable trade; (2) where the limestone is hard and compact; (3) for small operations; (4) where low first cost is desirable; (5) where the demand for lime is likely to be variable; (6) where labor is cheap and fuel high; (7) where power is not obtainable; and (8) where dust is liable to cause a nuisance.

[This paper will be published complete in a subsequent issue.—Editor.]

Science and Engineering in Lime-Burning

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The ordinary kiln, as ordinarily operated, cannot give a lime that is satisfactory in all respects. It is impossible to get low temperatures except at the expense of efficiency without resorting to special and only lately recommended methods of operation. What is needed to control temperatures in a lime kiln may be listed as follows:

1—It is essential that stone fed to the kiln be fairly uniform in size and preferably as small as is permissible from practical operating standpoints.

2—The producer gas and air must be supplied to the kiln at a definite rate. Both must be constant. Any variation will result in temperature fluctuations and lowering of kiln efficiency.

3—The gas and the air should be thoroughly mixed before they enter the kiln; otherwise there will be stratification into streams of variable oxygen content. This will in turn result in variable temperatures through the kiln and also lower kiln capacity.

4—The kiln must be operated at a definite rate proportional to the shaft cross section; otherwise there will be gas streams of unequal velocity, resulting in lime being burned higher in certain sections of the kiln than in others.

5—It is preferable to have gas and air under slight pressure and the kiln eye choked down, to assure fair velocity of gases when entering the kiln and their penetration to the kiln center.

6—The kiln must be so arranged by means of properly located piers and punching doors that when drawing the kiln can be properly punched and more lime removed from above the eyes and corners than from the center.

7—The drawing should be frequent, preferably every two hours, and the same amount of lime should be drawn each time. This is possible if the gas and air are supplied to the kilns at constant rates.

8—Hand firing is too inconstant to be even considered. Probably the best device is a gas producer of such type that the volatile matter will be driven off at a slow, steady rate. Low gasification per square foot of grate surface is essential except when automatic producers are used.

9—While drawing there should be no interruption in firing. Any cooling resulting from interruption may cause recarbonation and possible contamination.

10—Kiln temperatures should be controlled by dilution with waste gases. If cold kiln gas is employed, it will have to be reheated, causing a waste of heat.

11—The preferable location for removal of waste gas is immediately above the decomposition zone where the gas is still hot. If hot gas is recirculated, a very large amount may be used, thus effectively reducing kiln temperatures.

12—The blower or fan circulating the gas should be so arranged that it handles both air and recirculation gas mixed, thus lowering its temperature.

13—When desiring to hard-burn the lime, the recirculating gas amount should be reduced, increasing kiln temperatures. This also could be accomplished by drawing at a rate permitting the lime to remain longer in the kiln, or both systems may be employed.

14—When temperatures would be lowered for soft-burning lime, the decomposition zone would extend to greater heights owing to the lowering of temperature difference. This is due to lower rate of heat transference and consequently a necessarily longer time element.

15—If care is taken that the foregoing essentials are satisfied and if the kiln is so operated that high carbon dioxide, low oxygen, and no carbon monoxide are found in the waste gas, and if it is guarded against loss of heat by radiation, then the kiln capacity and efficiency, as well as lime quality, will be good.

[This paper will be published complete in a subsequent issue.—Editor.]

Needs and Future of Lime in the Chemical Industry

By James R. Withrow
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The chemical industry will never cease to need low-priced alkaline materials. In every industry the tendency is not only for the finished product to reduce in price comparatively, but for the raw materials to increase in price comparatively, if not absolutely—in other words, toward a smaller margin between raw material costs and selling price of product. The remedy sought is usually increased production. In the chemical industry, however, another method is ardently investigated—namely, the securing of better or lower priced alternative raw materials. Here lime will always have a future, provided those responsible for its production will be continually on the lookout for the market changes.

The need is not for *any* kind of lime. The need in the chemical industry is for the particular lime that will suit the particular chemistry or chemical engineering involved. This particular requirement will vary from process to process and from industry to industry, if not from plant to plant. Keenness in selecting the proper lime will result in great saving of process time. For instance, a slow-settling lime is exactly what is wanted for some chemical operations; otherwise, much time is lost through irregularity of dosage or administration of the lime suspension. On the other hand, a slow-settling lime would be disastrous to some chemical processes because it would unduly prolong the time of operation. In this case the selection of a quick-settling lime might more than double the capacity of a given chemical plant.

The purpose of this symposium was to educate two groups. It was the intention to educate all chemical workers to the great availability of lime as a manufacturing resource, and to introduce these chemical workers, by way of education to the needs of the lime industry, to the problems and to the kinds of solutions which will be of advantage to it as well as to the market. It was also the purpose of this symposium to educate the lime manufacturers to the great opportunity of the chemical manufacturing field and to all those uses in the arts to which lime can minister, so that these manufacturers may give the special attention necessary to make their particular lime render the maximum service.

The lime industry has had brilliant examples of real vision on the part of some of its business leaders. These men have struggled hard to get the lime producers to see the light, but lack of men to do the work, and lack of time on the part of those of us who are working on lime problems, and, above all, lack of vision on the part of those in the lime industry who are not yet awake to its great future, has made development less rapid in this part of the chemical industry than in most others.

This future cannot be grasped without work, without study of the consumer's problems, and without rendering the best service of which lime is capable. This demands knowledge, and still more knowledge, of lime, its properties, and methods of manufacture. The lime industry must be made a real chemical industry. To develop this basic industry into its full possibilities for service to industry and mankind requires the cooperation of the expert quarryman or mining engineer, the chemical engineer and production management, the chemical control man, and the sales and business management. The chemical industry constitutes an important and high-class portion of the market demand for lime.

The fact that lime is derived from abundant raw material insures its position as the lowest cost alkaline material at the disposal of chemical needs. Its future is only a question of rate of growth. We are only entering the consciousness of the value of chemical phenomena in the work of the world. As man's need for power and mastery of phenomena and production grows, we will more and more utilize chemical means and methods. This means greatly expanded demand for certain fundamental chemicals, mainly acid and alkaline in their nature. As an alkaline material, therefore, the future of lime is assured, but the lime producer will have much competition. He must fight for his future. Only those manufacturers with the backbone to use chemistry and engineering as weapons will win.

Section of the quarry face showing the bedding and natural water channels

Another view of the quarry face showing one of the natural caves in the side

Fine Grinding Limestone to 300-Mesh Without Preliminary Drying

Thompson, Weinman & Company Operation at Sparta, Tennessee

By J. R. Thoenen
Mining Engineer, Greenville, Ohio

OCCUPYING the summit of one of the foothills of the Cumberland mountains a short distance east of Sparta, Tenn., the quarry and plant of Thompson, Weiman & Co., when seen from the highway, reminds one of some feudal castle overlooking its broad and fertile tenancy. This impression, however, is quickly dispelled on closer acquaintance by the customary noise and activity attending a modern quarry and crushing plant.

Unlike most quarries and crushing plants, this operation produces one product only—fine ground limestones. No attempt is made to market either road or concrete stone in varying sizes, nor stone burned to lime. From appearance and analyses, any limestone product should be possible from this deposit. The company, however, has concentrated their whole operation to the one product, following and supplementing their activities in other fields.

This stone, of probable Upper Mississippian age, is rather thin-bedded near the top, with a slightly higher silica content. Lower down, the beds increase in thickness, with a corresponding increase in calcium carbonate content. At the base of the quarry lies a 10-ft. bed of rather coarsely granular soft white limestone, said to assay 98½% $CaCO_3$, while the whole 65 ft. of face averages 95%. The stone is quite soluble, as is evidenced by numerous vertical water channels, or chimneys and natural caves. These, together with the porosity of the stone, make for efficient drainage of the quarry, as well as of the stone itself. This feature of drainage is probably largely responsible for the successful fine grinding of this stone without preheating or drying.

There is practically no overburden to contend with, as can be seen from the illustrations. The whole quarry face is utilized in grinding, although some hand separation is made at the face.

Quarry Operations

Quarrying is carried on by drilling the face in benches from 6 to 8 ft. thick with Ingersoll-Rand, BCR 430, hammer drills. Drill holes are spaced 4 ft. apart and carry a burden of 5 ft. One line of holes is shot at a time.

The explosive used is duPont and Grasselli 40% low freezing gelatin detonated through No. 6 electric caps and battery. Six sticks of 1¼x8-in. explosive are used per hole.

Theoretically, the above performance figures to 1½ tons of stone per foot of drill hole and 3 2/3 tons of rock per pound of explosive, which closely approaches actual average practice.

Broken stone is sorted and loaded by hand into one-horse dump carts and hauled to the crusher, about 100 yd. from the quarry face.

The initial crusher, a No. 5 Austin gyratory, belt-connected to a 75-hp. induction motor, is set at 2-in. opening and operates in a pit with the receiving opening several feet below the quarry floor. As can be seen in the accompanying view, a cribbed plank wall confines dumped stone to a small area at the crusher head.

Crushed stone drops directly to a 14x6-in. belt and bucket elevator feeding a No. 2 Allis-Chalmers pulverator or hammer mill.

The product from the hammer mill passes to a 9x5-in. bucket and belt conveyor, discharging to a screw conveyor, which discharges into an elevated stock bin. This stock bin forms a break in the continuity of operation, allowing flexibility of operation between the coarse and fine grinding units.

From the stock bin the fine stone passes by gravity to three Raymond mills. These are of the four-roll, high-side type, built integral with 7-ft. separators, and belted to 75-hp. induction motors. Each mill and separator is a distinct unit.

The separators are equipped with No. 11 exhaust fans, which take the finished product from the deflectors and discharge it into the cyclone dust collectors.

Grinding

From the cyclone the fine stone feeds to a second screw conveyor discharging into the packing bins, from which it is sacked or barreled for shipment.

The feed to the Raymond mills is regulated automatically by the vacuum created by the exhaust fans. This arrangement prevents undo flooding and contamination of

Broken stone is sorted and loaded into one-horse dump carts for hauling to the crusher

Primary crusher in pit below the quarry floor. The cribbed wall confines dumped stone to area near the crusher head

the finished product by oversize. Thus regular operation and assured product are obtained with a minimum of attention.

The ground stone is packed for market in jute bags or wood barrels, as required by consumers.

The plant is located on a spur of the Nashville, Chattanooga and St. Louis R. R. and obtains power from the Tennessee Electric Power Co. There are no line shafts, each machine being connected to a separate motor.

Compressed air is furnished at 75 lb. quarry pressure by a 9x8 N. S. B. belt-driven Chicago Pneumatic compressor driven by a 75-hp. induction motor.

Plant Arrangement

The whole plant arrangement is on the straight line principle, which allows for future expansion by the addition of new units with a minimum of expense and confusion. There is at hand a fourth Raymond mill ready for erection as soon as market demands warrant it.

Operating on commercial filler requiring 75% through 300-mesh, the plant has a daily capacity of 150 tons finished product. For finer ground material required by certain markets (99½% through 300-mesh) the daily capacity is 80 tons. By hand selection of quarry product, stone can be marketed with a guaranteed 98½% $CaCO_3$ content.

The operation of the whole plant centers on an extremely fine ground limestone product. This material is utilized in a variety of ways, a few of which are rubber, putty and paint fillers, as a source of CO_2 in chemical plants, in lithogravure, and in chick and stock feeds.

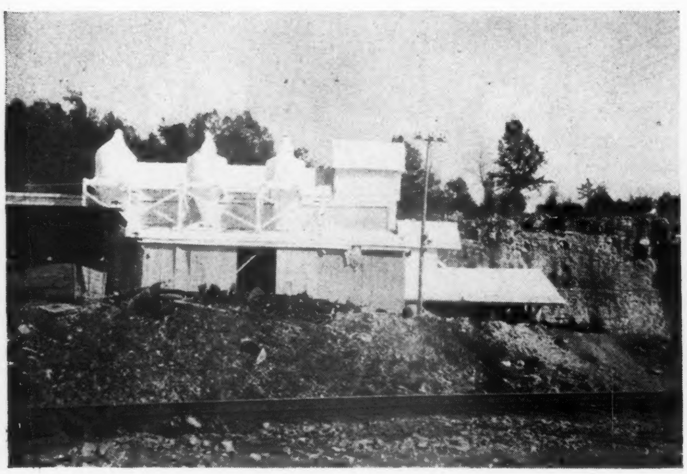
Although the finely ground limestone has an increasing commercial field, it has not yet reached that point which utilizes the immense quantities of small stone or spalls wasted annually by many producers. The art of fine grinding limestone offers many problems, which so far have been only partially understood; and while a short description of a plant such as this visualizes only the seemingly simple series of operations, obscure problems and difficulties arise, nevertheless, as can be affirmed by Homer Cook, the able superintendent in charge.

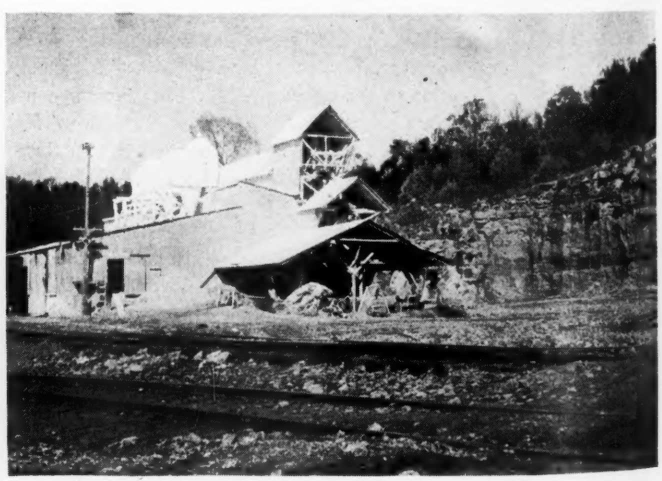
It is, therefore, of interest to note again that this plant takes quarry rock and, without preliminary drying, converts it into the finest of ground limestone, with guaranteed screen analysis as well as chemical content, as a primary operation.

Talc and Soapstone in 1925

THE total quantity of talc sold by producers in the United States in 1925 was 182,256 short tons valued at $2,011,793, an increase of 2% in quantity and a decrease of 10% in value, as compared with 1924, according to reports from the Bureau of Mines, Department of Commerce. The 1925 figures comprise 5684 tons of crude talc valued at $24,533, 895 tons of sawed and manufactured talc valued at $107,691 and 175,677 tons of ground talc valued at $1,879,-569. There were 23 producers of talc in 1925, the same as in 1924. Crude talc, other than refractory grade, was sold in California, Vermont and Virginia. The refractory grade was mined and sold in Maryland only. Ground talc was sold in California, Georgia, New Jersey, New York, North Carolina, Pennsylvania, Vermont and Virginia.

The larger part of the ground talc produced in the United States was used as a filler for paints, paper and rubber goods. Less than 1% of the talc mined was sold as cut pencils and crayons or blanks for refractory purposes. About 96% was ground to talc powder. No soapstone was sold in the crude form or quarry blocks during 1925, the report states.





Thompson, Weinman Co. plant near Sparta, Tenn. The entire operation is confined to the production of fine ground limestone

Rock Products Industry of South Dakota

Part I. Introduction—Andalusite—Bentonite—Feldspar—Gypsum

By Francis Joseph Lincoln
Professor of Mining, South Dakota State School of Mines, Rapid City, South Dakota

Editors' Note

SOUTH DAKOTA is probably the most rural of all our rural states. It is a land of great open places—great grain fields—with few centers of population, and therefore little demand for the most popular rock products.

South Dakota contains the famous Black Hills, which have yielded gold, and have given the state high rank for its mineral as well as its agricultural wealth. But the state is rich in rock products minerals as well as in gold, and the annual production of these is increasing.

We believe the chief interest and value in these articles, aside from the fund of geological knowledge in them, is the illustration they present of rock products industries flourishing under about the most adverse conditions to be found in the country.

—The Editors.

THE ROCK PRODUCTS INDUSTRY of South Dakota has grown rapidly during the past few years and the outlook for its future is most promising. That the output of rock products from South Dakota is a notable one, may be seen by a glance at Table I, which gives an incomplete approximation of the production of the state for the year 1925.

TABLE I—ROCK PRODUCTS PRODUCTION OF SOUTH DAKOTA FOR 1925

Material	Tons	Value
Andalusite	16	$635
Bentonite	885	3,540
Feldspar	2,000	8,000
Gypsum	10,031	57,891
Lithia minerals	1,014	40,900
Mica	377	9,430
Ochre	500	1,875[1]
Portland cement (sales)	63,457	607,570
Sand and gravel	370,000	370,000[2]
Stone (excluding state, county, city and town quarries)	287,053	366,677
Total	735,333	$1,466,518

[1]The preceding figures are from Ellerman, Otto, "Thirty-fifth Report of the State Mine Inspector of the State of South Dakota, Calendar Year Ended December 31, 1925."

[2]Rough approximation communicated by E. P. Rothrock, State Geologist.

This table also serves to indicate the wide variety of materials produced in South Dakota.

The principal producing areas are in the extreme eastern and extreme western sections of the state. In the eastern section, in the neighborhoods of Sioux Falls and of Milbank, there are outcrops of Algonkian rocks from which are quarried granite for monuments and quartzite for crushed rock, building stone and paving stone. In the western section of the state is the Black Hills region, where a domical uplift has been eroded to expose a core of Algonkian rocks surrounded by a succession of annular elliptical outcrops of sedimentary rocks, which dip outward and range in age from Cambrian next the crystalline center to Upper Cretaceous on the outskirts of the hills. All of the materials listed in Table I are produced in this region. The stone quarried in the Black Hills includes granite for monuments; sandstone for building stone; and limestone for crushed rock, portland cement, lime, sugar manufacture, building stone and decorative stone. Between the important producing sections at the eastern and western borders of South Dakota, the only rock products excavated are sands and gravels for local use on highways, or in construction work.

Andalusite

Andalusite is a contact metamorphic mineral with the composition of aluminum silicate. Until recently, while specimens of this mineral were to be found in most mineral collections and clear crystals and crystals of the chiastolite variety were occasionally cut as gems, the substance had no important economic use. Within the past few years, however, it was discovered that "artificial sillimanite" could be made from andalusite and used in the manufacture of high-grade spark plugs, and large quantities of andalusite have been mined for this purpose.

Andalusite occurs in the Algonkian core of the Black Hills associated with pegmatites. During the year 1925, trial lots to the total of some sixteen tons were shipped from the Black Hills deposits by three different producers, the Black Hills Mining Co. and George B. Grant, of Custer, and Mills Bros., of Hill City. The material proved suitable for spark-plug manufacture, but the prospects lacked the development necessary to insure large scale production, so the mining of this unusual mineral in the Black Hills has stopped for the present.

Bentonite

Bentonite is a very fine-grained and highly absorptive clay characterized by an alkaline oxide and alkaline earth content of from 5 to 10%. It has numerous uses, but all of that mined in South Dakota with the exception of a few trial shipments has been used in the manufacture of water softener. Other uses for bentonite are: A substitute for fuller's earth in petroleum refining; for the deinking of print paper; for making molds for steel foundries; in the manufacture of soap, for the medical dressing, anti-phlogistine, and

Peerless mine of the Keystone Feldspar and Chemical Co., Keystone, S. D.

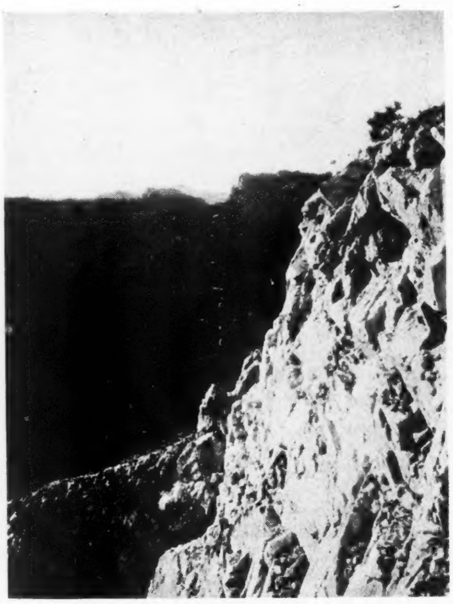
for a dressing and packing for horse's hoofs; as a retarder in gypsum wall plaster; as a filler in paper, pastes and inks; in the dressing of leather; as an adulterant of drugs and candies; and in the ceramic industry; and tests indicate that it might be used satisfactorily for a large number of other purposes.

Bentonite is found in South Dakota as thin beds in the Graneros and Pierre shales, which are of Upper Cretaceous age and outcrop on the outskirts of the Black Hills. In the southern Black Hills, the Pierre formation contains numerous beds of bentonite ranging from a fraction of an inch to 4 ft. in thickness and extending in a curved outcrop southwesterly from Buffalo Gap to Ardmore, S. D., a distance of about 50 miles. Fifty miles to the northwest of Ardmore, a somewhat different outcrop of bentonite occurs at Pedro, Wyo., which may be an extension of these same beds.[3] In 1916, 390 tons of bentonite were mined by two producers at Buffalo Gap,[4] who probably obtained their material 8 miles south of the town; where the sample, the analysis of which is given as No. 1 in Table II, was taken.

Ardmore is the only locality in South Dakota where bentonite has been mined on a commercial scale. The Refinite Co. of Omaha, Neb., completed a plant for the manufacture of water softener from bentonite at Ardmore in 1917, and has been mining bentonite regularly since that date. From 1917 to 1925, inclusive, this company mined 6135 tons of bentonite valued at $54,-790, according to the annual reports of Otto Ellerman, state mine inspector. Superintendent J. B. Wherry reports that in 1926 he mined some 1600 tons valued at about $6400.

Analyses of the Ardmore bentonite furnished by the Refinite Co. are given in Table II. This material differs in some respects from other bentonites, the principal difference being that it will not remain in suspension in water indefinitely, and is therefore sometimes called "ardmorite." It occurs near the top of the Pierre shale in nearly horizontal beds of from a few inches to 3 ft. in thickness. The bentonite is stripped with a ¾ yd. Bucyrus revolving steam shovel mounted on caterpillars, which removes an average of 18 ft. of overburden. The bed of bentonite is then drilled with hand twist drills and blasted with 40% dynamite. The loosened material is shoveled into motor trucks and hauled to the plant, which is located on the railroad about a mile distant from the mine. Mining operations are completed in the late summer or early fall in order to take advantage of the favorable weather.

At the plant the raw material is manufactured into grains suitable for use in filter beds through which the water to be softened is passed. On account of the special use to which the product is to be put the milling is more complicated than for most bentonites, according to Ladoo. The material is first weathered in stock piles, then partly disintegrated on steam coils, next broken by hammer mill and the impurities removed by screening, when the fine crushing is effected with disintegrators. The finely ground



Huge mine at Keystone, S. D.

material is mixed with water in a pug mill and the plastic product fed to an extrusion press which forces it through a die in small strings 1/16 to ⅛ in. in diameter. The bentonite strings are placed in wire baskets which are racked on cars passing through a steam-heated drying tunnel. A hammer mill breaks the dried strings, the dust being screened out and returned to the feed, while the granular product is passed through a 6x60-ft. oil-fired rotary kiln, where it is baked at a high temperature. The baked material is rehydrated with hydrating solution in steel vats heated by steam coils, and the rehydrated product washed in 3x12-ft. wooden towers, screened to remove fines, drained and packed in barrels or placed in storage vats. The product is known as "Refinite." It has been shipped to practically every state in the Union, and to many foreign countries, including Canada, England, Denmark, Italy, China, Japan and several South American nations.

Near Belle Fourche, at the northeastern edge of the Black Hills, bentonite occurs in a 3-ft. fed in the Graneros shale, about 8 ft. above the Mowry shale member.[8] Analyses of this material are included in Table II. It is yellow in color and forms a jelly-like mass on suspension in water, thus closely resembling the bentonite from Wyoming, which was the first to be described, and differing from the Ardmore variety. Several trial shipments have been made from the Belle Fourche deposits, although no regular mining operations have been undertaken. According to the state mine inspector, W. G. Robinson shipped 100 tons from the Stetta lease to New Jersey in 1923 and 111 tons in 1924; while the Belle Fourche Bentonite Products Co. shipped 43 tons from its property to Chicago in the latter year.[9]

Feldspar

Potash feldspar of high quality occurs in the pegmatites in the Algonkian core of the Black Hills, and large deposits of this mineral exist in the neighborhood of Custer and Pringle in Custer County and of Keystone in Pennington County. The composition of South Dakota feldspars from three typical localities is shown in Table III.

The white feldspar, No. 2, consists mainly of microline (potash feldspar) with 2 to 3% of albite (soda feldspar) and amblygonite (lithium aluminum phosphate) as an accessory mineral. It fuses at Cone 8 plus

TABLE II—ANALYSES OF SOUTH DAKOTA BENTONITES

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
		Ardmore	Ardmore, 1927[6]				
	Buffalo Gap[3]	1921[5]	High	Low	Average	Belle[7]	Fourche[3]
SiO_2	51.1	55.22	49.8	55.1	54.8	59.34	60.64
Al_2O_3	15.4	21.00	21.0	24.2	23.8	22.70	23.26
Fe_2O_3	4.5 (with MnO_2)	3.61	1.9	4.0	3.7	3.92	3.92
MnO_2		....	None	Trace	.....	....	....
TiO_2 (Inc. with SiO_2)	....	....	.....	....	.....	....	0.12
CaO	5.2	4.94	2.4	5.5	4.9	1.27	0.59
MgO	3.8	3.04	1.0	3.5	2.4	2.57	2.19
K_2O	1.5 (with Na_2O)	....	None	0.23	.....	....	0.37
Na_2O		1.56	None	0.65	0.3	....	4.33
SO_3	....	0.43	0.3	1.9	1.5	0.39	....
S	....	....	None	0.35	0.2	....	....
CO_2	(1.4)	Trace	.....	....	.....	....	....
Cl	....	....	None	0.17	.....	....	....
Ign. loss	....	....	.....	....	.....	5.75	....
H_2O	4.0	10.28	3.1	7.6	7.5	3.84	2.83
H_2O—	13.1	....	.....	....	.....	....	....
	100.0	100.08				99.78	98.25

[3]Wherry, E. T., "Clay Derived from Volcanic Dust in the Pierre in South Dakota," Jour. Wash. Acad. Science 7 (1917), 576-583.

[4]Ellerman, Otto, "Twenty-seventh Annual Report of the State Inspector of Mines for the State of South Dakota—Year Ending December 31, 1916."

[5]Ladoo, R. B., "Bentonite," Bureau of Mines, Reports of Investigations, Serial No. 2289, October, 1921, p. 5. Analysis No. 2 furnished by the Refinite Co.; Analysis No. 7 made by W. A. Selvig, U. S. Bureau of Mines.

[6]Analyses kindly furnished by the Refinite Co.

[7]Analysis by C. Bentley, S. D. Mining Exp. Sta., S. D. State School of Mines.

[8]Connolly, J. P., Circular 16, S. D. Geol. and Nat. Hist. Survey, April, 1924, p. 14.

[9]Fellows, R. O., "Bentonite in South Dakota," Letter, Eng. and Min. Jour. 122 (1926), 182.

(1300 deg. C.), and when fused is exceptionally transparent and free from color. The pink feldspar, Analysis No. 3, is similar in composition to the white feldspar of Analysis No. 2, save that it contains accessory muscovite and occasional minute spots of intense red iron oxide. It fuses at Cone 8 (1290 deg. C.), as does the general run of Canadian feldspar, and when fused is semi-transparent and free from color like the imported material.

These analyses and tests clearly indicate the high quality of South Dakota feldspar. The phosphate content shown in analyses No. 2 and No. 3 especially recommends these feldspars to the metal enamel industry, which is an important consumer of feldspar.

TABLE III—ANALYSES OF SOUTH DAKOTA FELDSPARS

	No. 1 Keystone[10]	No. 2 Dakota Feldspar Co. Mine (White) Near Pringle[11]	No. 3 Trick Mine (Pink) Pringle[11]
Ignition loss	......	0.33%	0.44%
SiO_2	63.57%	65.16	65.21
Al_2O_3	20.96	18.86	19.05
Fe_2O_3	0.07	0.15	0.18
TiO_2	......	Trace	Trace
P_2O_5	......	0.27	0.44
CaO	0.20	0.04	0.04
MgO	0.32	0.05	0.08
Na_2O	2.65	3.64	2.85
K_2O	12.03	11.31	11.63
	99.80%	99.81%	99.92%

[10]Roos, A. T., "Feldspar Industry and the Tariff Question," Cement, Mill and Quarry, Feb. 20, 1926, pp. 77-78, "Average analyses of shipments from Pennington Co., S. D., to grinding mills, Murphysboro, Ill., 1924."

[11]Watts, A. S., Unpublished report kindly supplied by Dr. A. T. Roos.

Feldspar mining is a new industry in the Black Hills. Until recently, high freight rates and low prices on feldspar combined to make its shipment from this region unprofitable. In 1923, largely through the efforts of Dr. A. T. Roos, lower freight rates were secured, and the Keystone Feldspar and Chemical Co. began to make shipments, which have continued down to the present day. Other companies in the Black Hills have commercial deposits of feldspar upon their properties, but the present price is too low to permit of their mining, dressing and shipping the feldspar at a fair profit, so their deposits are being held in reserve. If the bill now before Congress proposing a $3 import duty on raw Canadian feldspar becomes a law, it will greatly stimulate feldspar mining in the Black Hills.

The Keystone Feldspar and Chemical Co. operates at Keystone, a small town at the terminus of a 14-mile spur from the Burlington Line. John A. Schreiber is manager. In 1923 this company shipped 150 tons of feldspar, valued at $3,000, and in 1924 it shipped 1800 tons with an estimated value of $7,200. This feldspar was obtained partly by mining, but largely from the old dumps of the Hugo, Etta, and other lithia mines of the district. It was necessary to dress the feldspar by cobbing and sorting in order to free it from such impurities as quartz, muscovite, biotite, iron oxide, manganese oxide, and black tourmaline; and according to Superintendent Emil S. Hesnard, the cost of cleaning the feldspar far exceeded the cost of mining it.[12]

The Keystone Feldspar and Chemical Co. purchased the Peerless mine at Keystone and leased the Hugo mine, a mile distant. In 1925 it shipped 2000 tons of feldspar valued at $8,000, and in 1926 more than doubled this record by shipping 105 carloads, or about 4500 tons, of feldspar. All of this feldspar went to the grinding mill of the Innis-Speiden Co. at Murphysboro, Ill. The character of this feldspar is shown by analysis No. 1 in Table III, which is a composite analysis of shipments made during 1924.

Analysis No. 2 is of white feldspar from the mine of the Dakota Feldspar Co., situated 5 miles northeasterly from Pringle, a small town on the Burlington Line. At that property a carload of feldspar has been mined and a large tonnage exists. A. T. Roos of Rapid City is manager, and he and his associates own the Trick pink feldspar mine at Pringle, the product of which is represented by Analysis No. 3.

Gypsum

Gypsum occurs abundantly in the Black Hills in the Spearfish formation of the Triassic age. The red shales of this formation outcrop as a depression, which varies in width from a few rods in a single instance in the southern Hills to a more usual width of 3 miles, and which is known as the Red Valley. This valley swings around through the Black Hills in a gigantic ellipse with a north-south diameter of about 100 miles and an east-west of about 50. Gypsum beds are present almost throughout this exposure. The red beds vary in thickness from 350 to 700 ft., and the gypsum occurs at various horizons in layers ranging from a fraction of an inch to 30 ft. in thickness.[13]

[12]"The Mining of Feldspar near Keystone," *Black Hills Engineering* 13 (1925), 35-6.

Black Hills gypsum is of good quality, as shown by the analyses in Table IV.

TABLE IV—ANALYSES OF SOUTH DAKOTA GYPSUMS

	No. 1 Black Hawk 20-ft. bed[14]	No. 2 Hot Springs 25-ft. bed[15]	No. 3 Cascade Springs[16]
SiO_2	0.16%	0.11%	0.10%
Al_2O_3	0.12 (with Fe_2O_3)	0.10 (with Fe_2O_3)	0.12
Fe_2O_3			......
CaO	32.27	32.95	32.44
MgO	0.58	0.19	0.33
SO_3	44.59	44.86	45.45
CO_2	......	......	0.85
H_2O	......	......	20.80
Ignition loss	20.48	21.13	......
	98.20%	99.80%	100.09%

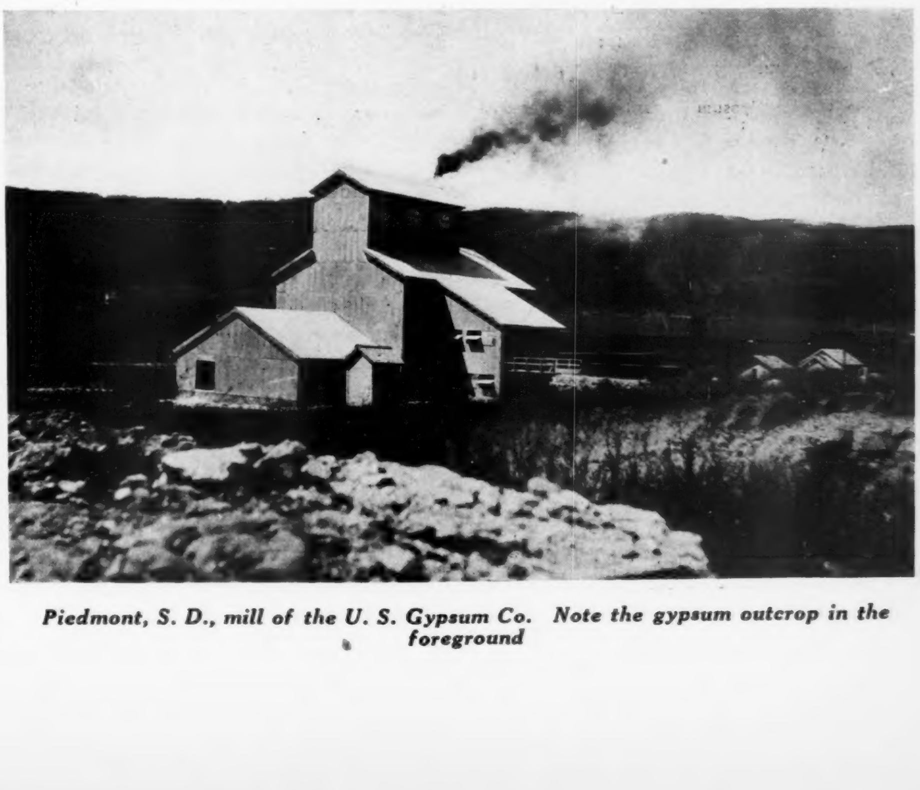
Gypsum was one of the first non-metallic minerals mined in the Black Hills. As early as 1884, small gypsum mills were in operation at Spearfish, Crook City, Sturgis, and Rapid City, producing plaster for local use. Rapid City produced 7½ tons in 1884, and in 1886 this production was increased to 80 tons of plaster, 30 tons of which were

[13]Hutton, J. G., "South Dakota" in "Gypsum Deposits of the United States," Bull. 697 (1920), U. S. Geol. Survey, 239-249.

[14]Analysis by C. G. Ehle, S. D. School of Mines Bull. 10 (1914), 213.

[15]Average of 2 analyses by M. F. Coolbaugh, S. D. School of Mines Bull. 10 (1914), 213.

[16]Analysis by G. Steiger, 21st Ann. Rep. U. S. Geol. Sur., Pt. IV (1901), 585.



Piedmont, S. D., mill of the U. S. Gypsum Co. Note the gypsum outcrop in the foreground

exported to Norfolk, Neb.[17] The Hot Springs Plaster Co. operated continuously from 1893 till 1909, when its plant was burned to the ground. Two kettles were employed, making a daily output of 60 tons, which included hard wall, finish, and dental plasters.[18] The ventures of the Hot Springs Gypsum Co., which erected a plant at Erskine near Hot Springs in 1911, and of the National Alabaster Co., which erected one at Alabaster near Hot Springs in 1912, did not meet with success. The Pettigrew Stucco Co. operated a small one-kettle mill at Spearfish from 1898 till 1912, producing about 1 ton of hair plaster a day. In 1907, E. S. and H. W. Johnson erected a mill for the Black Hills Gypsum Co. 2 miles northwesterly from Rapid City near the present site of the state cement plant. This plant was purchased by the United States Gypsum Co. in 1908 and operated by them until it burned down in November, 1915. It was a one-kettle mill with an average output of 100 tons of stucco a day. Mining was first conducted by the open-pit method, but was changed to underground work when the stripping became prohibitive.

At the present time two gypsum companies are operating in the Black Hills—the Dakota Plaster Co. at Black Hawk, 7 miles northwest of Rapid City on the Northwestern Line, and the United States Gypsum Co. at Piedmont, 7 miles farther to the northwest on the same railroad. The first mill of the Dakota Plaster Co. was built in 1910 and burned in the spring of 1916. It was reconstructed and put in operation again the following spring, and has been in continuous operation since that time. After the burning of its Rapid City mill in 1915, the United States Gypsum Co. purchased its Piedmont property and constructed a new plant there, which also went into operation in the spring of 1917 and has operated continuously since.

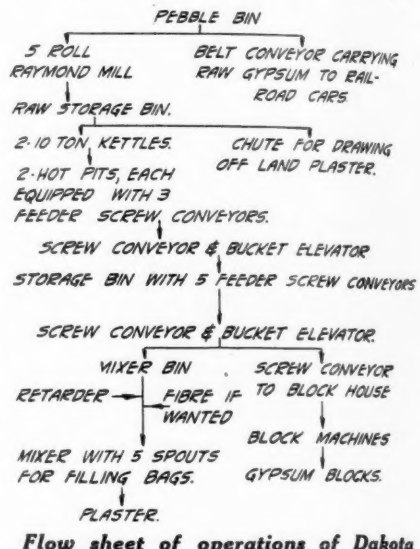
The home office of the Dakota Plaster Co. is in Rapid City and A. M. Lanphere is manager. The quarry at Black Hawk near the mill was first worked as an open pit, then by the underground room and pillar method, and is now again being operated as an open pit. A deposit of gypsite on the property was formerly mined with scrapers, but only gypsum is produced at present. The gypsum bed exploited has a thickness varying from 18 to 28 ft., and the composition shown by Analysis No. 1 in Table IV. The gypsum is drilled with a Howells electric auger drill which is mounted on a truck for convenience in moving. This drill is actuated by a 3-hp. 220-v. electric motor and is capable of drilling a 1½-in. hole 15 ft. deep. Holes are drilled about 6 ft. apart and at an average distance of 3 ft. from the face of the cut. They are loaded with 20% dynamite, 15 sticks being an average charge for a 15-ft. hole, well tamped, and fired by electricity, using No. 6 electric caps.

The broken gypsum is loaded by hand into 1-ton quarry cars which are hauled up an inclined track to the crusher house by means of a 5-hp. electric hoist. There a 28x14-in. jaw crusher reduces the gypsum to a maximum size of 2½ in., and is followed by a rotary pot crusher which further reduces this maximum to ¾ in. An 18-in. belt conveyor carries the crushed gypsum to the pebble bin at the mill. The mill flow sheet is illustrated herewith. The company has its own fibre machine with which it manufactures wood fibre from cottonwood. Electric power is employed throughout the plant, electric motors of 440 v. totaling 186 hp being used on the mill, crusher house and hoist.

The Dakota Plaster Co. sells some raw pebble gypsum to the South Dakota state cement plant at Rapid City, and occasionally fills orders for land plaster; but its main business is in plaster — wood-fibred, hair-fibred, and unfibred — and in gypsum blocks of 2-in., 3-in., 4-in. and 5-in. thicknesses. During 1925 it produced 5035 tons with a total value of $29,065.

The United States Gypsum Co. has its home office in Chicago, and refuses to permit inspection of the Piedmont plant, or to give out detailed information concerning it. The following description is therefore very incomplete.

Gypsum is mined from underground workings near the mill, by the room and pillar system. An electric auger drill is used as at the quarry of the Dakota Plaster Co. Horses haul the gypsum to the north of the mine, and it is hoisted to the mill by an electrically-powered hoist. The mill is of steel construction and is equipped with a 4-roll Raymond mill and one 10-ton kettle. Besides mining gypsum, the United States Gypsum Co. mines gypsite from the surface of its property near the mill by means of horse scrapers. This gypsite is mixed with the proper proportion of ground gypsum and manufactured into a dark colored plaster. The other products of this company are similar to those of the Dakota Plaster Co.,



Flow sheet of operations of Dakota Plaster Co. at Black Hawk mill

save that it makes no blocks. During 1925 it produced 4996 tons with an estimated value of $28,826.92.

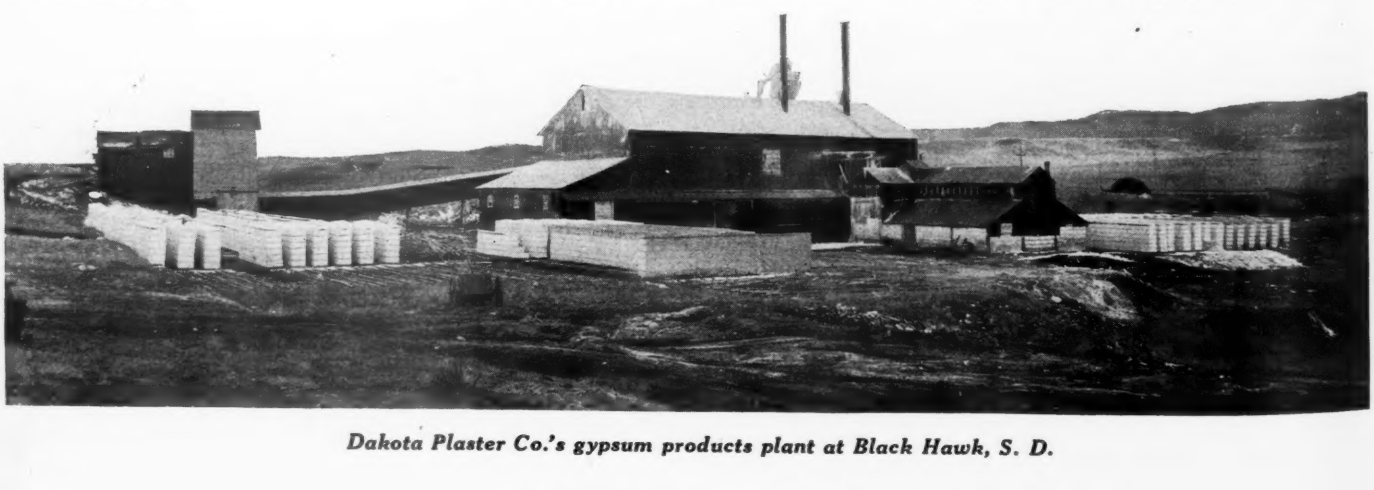
(To be continued)

Doing Export Business

THE Foreign Commerce Department, U. S. Chamber of Commerce, has recently brought out an interesting little booklet, "Doing Export Business," designed to furnish information on the possibilities and methods of conducting an export business. It contains much useful data based on experiences of other concerns who have built up successful trade abroad. Copies are available at 15 cents per each on application to C. D. Snow, manager, Foreign Commerce Department, Washington, D. C.

[18]Ehle, C. G., "Gypsum Deposits and the Stucco Industry in the Black Hills," unpublished thesis, S. D. State School of Mines, 1911.

[17]Mineral Resources of the U. S. for 1883-4, p. 812, and 1886, pp. 622-3.



Dakota Plaster Co.'s gypsum products plant at Black Hawk, S. D.

Air Separation Methods Used in Fine Grinding of Rock Products

II.—Application of Air and Centrifugal Force—Design of Machine

By Edmund Shaw
Editor, Rock Products

THIS is the second of a series of articles, the first of which was published in Rock Products, April 2, 1927. It described the usual methods of fine grinding rock products, showed that the mill product was divided into sands, dusts and cloud-forming dusts and gave the definition of these according to the rate of fall of each in still air. This number describes the application of air and centrifugal force in simple theoretical devices. The succeeding numbers deal with the separators which are actually in use.

How the Air May Be Applied

In all air separators air is applied in some way to overcome the force of gravity. This is common to all air separation machines of any type. But in the modern air separator centrifugal force is also applied and it is this which gives such machines an efficiency that could not be attained otherwise. Leaving this for the present, however, some of the methods of applying air to overcome the force of gravity may be considered. The simplest perhaps is that shown in Fig. 2

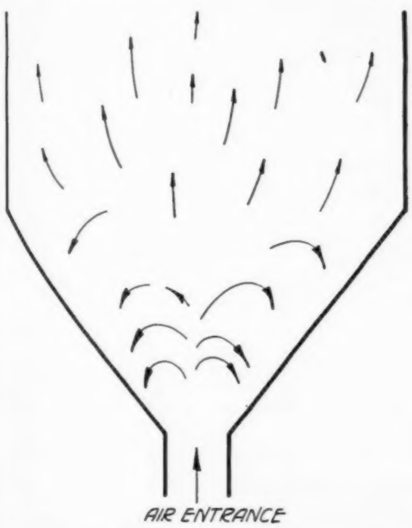


Fig. 2. Simplest form of air separator. Only the fines are discharged

which is the method of the air analyzer and a similar device called a "flourometer".

The device consists of an inverted cone terminating in a long vertical tube. The feed is put into the cone and the air blast is started. As the air expands in the tube its velocity becomes proportionately less. Consequently the heavier particles are lifted for a short distance and then fall back to be again lifted. The lighter particles are not heavy enough to resist the lowest velocity of the air in the cone and so they pass up and out of the straight tube.

Fig. 3 shows a variation of this principle providing for a discharge of the heavy as well as the light particles. The suction of a fan supplies the air current that lifts the lighter particles from the heavy and an adjustable gate allows the heavy particles to be discharged as fast as they accumulate.

The effect of a side current of air on a stream of particles is shown at Fig. 4. The current blows the lighter particles away from the heavy so that they fall on one side of a partition, the same way that chaff is blown away from grain.

In Fig. 5 both air and feed enter into one side of a closed box. The force of the air is not sufficient to carry the heavy particles all the way through the box so they drop out and are collected in the box.

The figures shown represent not practical but elementary theoretical devices which work with only one separating force, and are intended to illustrate only principles. But all of the methods of separation shown have been actually used in practical machines. Another method of applying the air, that which is used in the "dry washer" mentioned, might have been shown, but this has never been used so far as the writer knows except in concentrating and not as a sizing device, although it could be so used.

Applying Centrifugal Force

Centrifugal force has been applied in a number of machines for separating crushed material into sizes. One of the simplest of these which will serve to illustrate the principle is shown diagramatically in Fig 6. The feed goes into a hollow tube which surrounds a shaft and falls on a revolving plate. The particles are thrown off the edge of the plate and the heavier particles are thrown farther because the lighter particles are stopped more quickly by the resistance of the air. The separated sizes fall into circular troughs surrounding the plate. A revolving plate of this kind is an essential part of many of the air separators which are found in use today. Applied as shown in the diagram without air separation, it has actually been used in the concentration of ores.

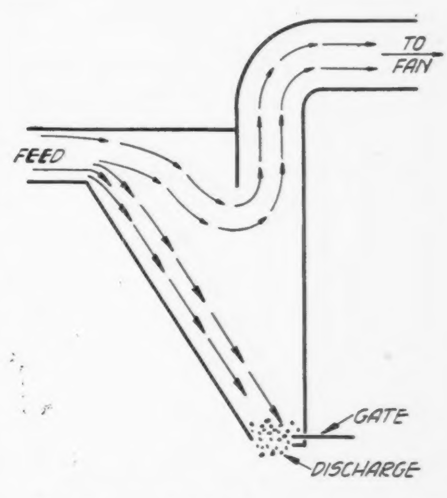


Fig. 3. A simple air separator with both coarse and fine discharges

But a better known application of centrifugal force is to be found in the "cyclone" used as a dust collector in so many industries. This is shown in plan and section in Fig. 7. It is made in several forms, that shown being about as simple as any. The air and the feed (usually dust) enters in the upper cylindrical portion at an inlet placed tangentially to the circular wall of the upper part. This sets up a whirling current as shown by the arrows. The dust is carried outwardly by this current and clings to the walls and makes its way down to the bottom cone by gravity. The air escapes through the central pipe shown. The cyclone, it will be seen at once is an air separator of a simple form as well as a collector, for if the upward flow through the outlet pipe is strong enough it will suck up the

lighter particles according to the principle illustrated in Fig. 3. Here we note a similarity with devices that settle fine material from water. If we run the stream into a box and allow it to overflow, the character of the overflow will depend on the relation of the size of the box to the quantity of water flowing into it. If the box is big enough (or the amount of water flowing is small enough) everything will be settled in the box and the overflow will be clear. The box is then a collector and not a classifier. If the box is made smaller in proportion to the water current fine grains will over-flow and if it is made small enough nothing will settle in the box.

This principle applies to cyclones and air separators. If they are large enough all the dust will settle (except perhaps the cloud forming dusts which never settle) and if they are made small enough only the coarser material, fine sands, will be discharged at the

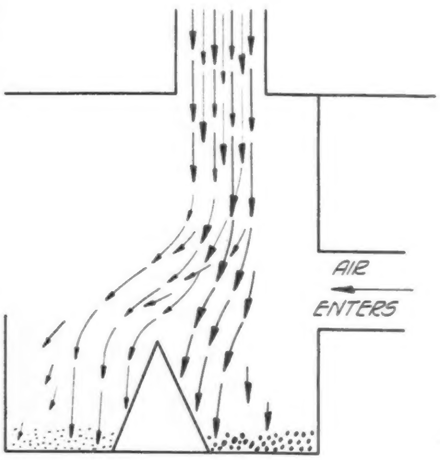


Fig. 4. Separating by blowing air through a falling stream of partcles

outlet at the bottom and the dust will go to the outlet.

But though there is this connection between separators and collectors, the true collectors, of which there are many on the market, will not be treated here. Dust collection is distinctly a different subject from air separation.

Separating Line the Resultant of Two Forces

It is a well known principle that when a body is acted upon by two forces at right angles it follows a path along what is known as the resultant of these forces. This explains what happens in an air separator which uses centrifugal force in combination with a lifting air current. The diagram, Fig. 8, will explain this easily. This is the familiar parallelogram of forces. The horizontal component (c) is the centrifugal force which throws the particle outwardly toward the wall of the separator. The vertical component (v) is the lifting force of an air current. The resultant of these two forces (r) is the path a body would follow from being acted on by these two forces only.

Every particle may be considered as starting out on this path (r). But there are other forces acting which cause it to leave the path and take another path, as is

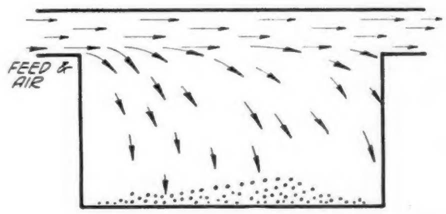


Fig. 5. Heavy particles falling from a carrying current of air

shown by the arrows in the diagram. The particles meet the resistance of the air, which affects the light particles more strongly than the heavy particles. So they are checked in their outward movement and the lifting air current catches them and draws them out of the separator. The heavy particles are acted upon much less by the resistance of the air and more by the action of gravity, so they tend to fall out of the resultant path, and, as gravity acts at an accelerating rate, once they are out of the path they fall down into the body of the separator and go out of the coarse discharge pipe at the bottom.

How the Centrifugal Effect Is Produced

Various devices have been invented to produce the centrifugal effect, but in the end they resolve themselves into three methods. These are:

1. The air is caused to enter tangentially in a cylindrical space as in the cyclone collector just described and in such separators as the Federal.

2. The air is passed through a series of

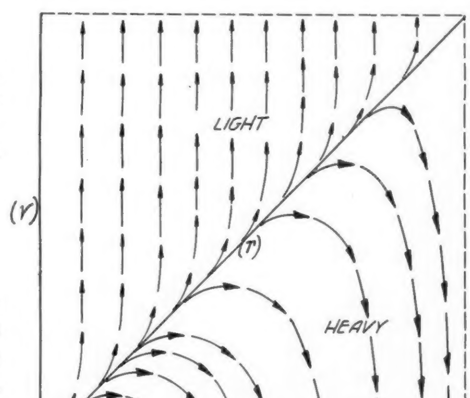


Fig. 8. The line on which separation occurs is the resultant of the vertical air current and the horizontal centrifugal force

blades set at an angle on a circle. These blades break up the air current into a number of tangential currents that unite to form a whirling body of air. This is the method used in the Raymond, Sturtevant and other separators.

3. The air holding the particles is kept whirling by the blades of a fan above the feed plate. This is employed in the Gayco separators, and the fan may have other uses in addition to that of causing centrifugal motion.

According to the manufacturers of air separators, each of these methods has its especial advantages. The first requires no moving parts of any kind, but it lacks some other adjustments than those obtained by varying the air current. The second has a ready means of adjustment by varying the angle of the blades and is also without moving parts. The third is claimed by the designers who use it to be more positive in

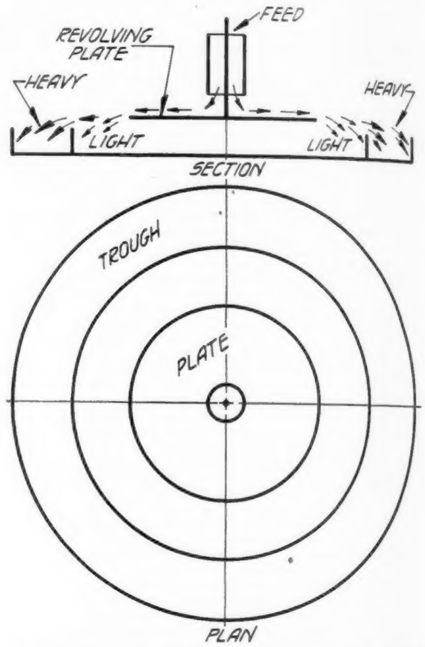


Fig. 6. A separator employing centrifugal force without air current. This has been used in ore concentration

its action and hence adaptable to be used with low-velocity air separation.

Elements of Design of Air Separators

From what has preceded this we see that air separators, like other machines, are susceptible to design; that is, the parts of the machine may be so constructed that they are adapted to the work they have to do. And the elements of design may be given as follows:

Size. Size, as in other separating devices, has two functions, that of regulating the *quantity* treated and that of regulating the *fineness* of the separation. This may be best illustrated by the simplest of separating devices, the screen. If a coarse mesh screen is used, enlarging the screen will enable it to treat a proportionally larger quantity. But if it is desired to separate the *same* quantity on a finer mesh size the screen must be enlarged due to the lessened efficiency of the finer mesh. The same relation holds true of air separators, that is, the

larger size may be employed to treat a larger quantity making a coarse separation or a smaller quantity on a fine separation. So important is this matter of size that many air separators are made in a number of standard sizes. One manufacturer advertises 31 sizes and another, sizes running from 4 ft. diameter to 14 ft. diameter.

Adjustments. Size is not adjustable, but adjustments of parts may be made to do the same thing as increasing or decreasing the size within certain limits.

Balance of Forces. If Fig. 8 is considered it will be seen that the separation made will depend on the relative strength of the two component forces v and c. If v is increased in proportion to c more material will be lifted and the separation will be on a coarser size. If c is increased in proportion to v, the particles will be thrown farther out and away from the influence of the lifting current v and the separation will be on a finer size. The attaining of this relation of forces and its adjustment is a matter of design.

Speed. A very important feature of air separators in which both the lifting force and the centrifugal force are obtained from the same fan is that the resultant (r) does not change its position when both the lifting force (v) and the centrifugal force (c) are increased by speeding up the fan. This keeps air separation constant regardless of changes of speed. An increased speed of the fan in most machines enables it to handle more feed without changing the quality of the separation. In some machines, however, the rate of speed is arranged to affect the separation and a change of speed is a regular adjustment. The effect of speed is therefore a matter of design.

Nature of the Material. As has been already explained, the separation is affected by the nature of the material. Light "fluffy" substances, even though the grains are of fairly large size, will lift much more easily than substances that produce small, well rounded grains. Some organic materials, such as alfalfa meal, are said to be very difficult to separate at all, as all sizes of grains follow the air current. Certain mineral products have something of this tendency and this must be allowed for in designing.

It is unfortunate that no very thorough study of the behavior of mineral grains and dusts in an air current has been published. It is doubtful if any has been made. All the manufacturers of air separators who were asked about this said that they knew of nothing corresponding to the work of Ritinger, Richards and others on settling rates in water and their application to hydraulic separation. Air separators are built on empirical lines, and while the results obtained by them are good, the whole matter of design and operation will be improved to a considerable degree when such studies have been made.

Early Forms of Air Separators

There are English patents taken out as early as 1860 relating to air separators. But the machines do not seem to have come into use until the Peifer machine was introduced in Germany and Belgium. It appears to have met with indifferent success and the design and construction of air sep-

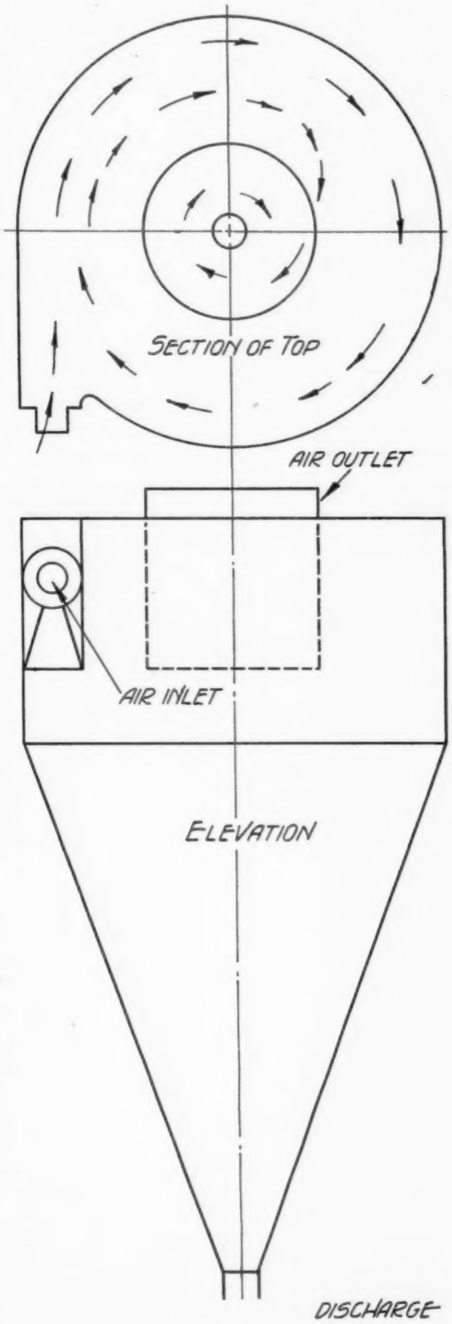


Fig. 7. One form of the well-known cyclone collector

arators languished for a number of years. About 1918 newer types began to be developed and there has been considerable progress in the art until the present time and the progress promises to continue.

In general the early as the modern forms of air separators divide themselves into two classes, those which employ moving parts to create a centrifugal action and those which use vanes or plates on a tangent to give the body of air a whirling motion. So far as modern separators are concerned, the latter is the older type and it is best exemplified in the air separator used as an integral part of the Raymond mill. The other type was introduced in America by George Emerick, an inventor, who built many types of air separators and introduced them successfully in several industries. The Emerick patents were taken over by the Rubert M. Gay Co., which now manufactures the Gayco separators.

(To be continued)

Sensitiveness of Explosives and Sensitiveness Tests

THE March number of the *Explosives Service Bulletin* published by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., contains an interesting article of the above title by Arthur La Motte, manager of the technical section of the du Pont company. In it Mr. La Motte defines the field test for sensitiveness, its object, limitations, conditions for accuracy, and compares it with the lead plate test of detonators.

The test consists of determining by a series of trials the maximum space between two half-cartridges, 1¼ in. in diameter, which will carry the detonation initiated by a detonator in one half-cartridge to the other half-cartridge with no detonator in it, the two half-cartridges being wrapped, with their cut ends facing each other, in a sheet of paper of standard grade and size and this tube being laid horizontally on the ground.

Once a standard is obtained for a given type of explosive, it is a feasible thing to compare it with the results for any particular lot of the same type of explosive and draw a reliable conclusion as to whether deterioration has occurred and how much and whether the lot is fit for use.

Dust Respirators for Workers in the Rock Products Industry

RECENTLY the Bureau of Mines has gathered considerable data on the effects of breathing rock dusts on the health and safety of workers. It was found that dust particles of the order of one micron in diameter were the most harmful to the lungs. Of the insoluble dusts, those of hard rocks, such as silica or metal dusts, which are sharp-cornered and sharp-splintered, were most dangerous. Working on this basis, a new form of dust respirator was designed and constructed. The efficiency of this respirator is 93% against silica dust.

The report states that the use of respirators should be encouraged in dusty industries, but efforts should be more directed to prevent dust formation and distribution by using hollow drill steel and water or other means. Complete information on these dusts and their investigations, respirators, etc., are contained in Technical Paper 394, Bureau of Mines, Department of Commerce.

Fineness of Portland Cement and Its Effect on the Rate of Hydration*

By Albert Hauenschild

THE purpose of this research work was to separate further sizes of the cement passing the 4900-mesh sieve, obtaining quantities sufficient for complete mechanical and physical tests of these sizes. Special attention was also paid to the effect of fineness on the rate of hydration.

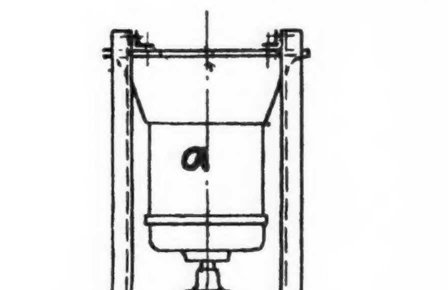
As the Gary-Lindner apparatus first used in these tests permitted the separation of only 20-gram samples of cement, the author made an attempt at enlarging it. These tests failed, however, as the larger device required higher air pressure to penetrate through the upper layers of cement, which made the results non-uniform. A part of the finest powder also became lost in the air current. The author, therefore, designed a completely sealed air centrifugal with which he obtained satisfactory results when operating uniformly and continuously. This device made it possible to separate any desired quantities of the different sizes.

Testing Apparatus and Procedure

The apparatus, which is shown in the illustration, consists of a feeding tank *B*, from which the cement, which is first passed through the 4900- or 10,000-mesh sieves, is fed to the spraying plate by means of screw conveyor. A propellor *D* is fixed above the spraying plate *C*, which brings the air into rotation. The cement falls on the spraying plate in a thin stream, is dispersed and forms a dry emulsion with the air, from which the different sizes are gradually separated in the bottom part of the device and settle in the different containers *e*, *f*, *g* and *h*. The larger particles settle in the outer compartments, while the finest are found near the center. The diameter of these containers is selected in such a way that the area of each is one-fourth of the entire cross-section area.

The drive is furnished by a directly connected motor *A*. The original device had a power transmission with leather belt and pulley. As slipping was found to occur, the present arrangement was preferred. The completely sealed feeding conveyor is operated by a worm gear, so that the feeding of the cement is as uniform as possible. The tube, through which the cement is conveyed to the spraying device, is also completely sealed, so that it allows no access of air nor permits any cement to escape.

The tests were run at 2180 r.p.m. The air pressure inside the apparatus was 14 mm. at the circumference, while an equivalent vacuum was produced in the inner part. The apparatus could have been made with a larger diameter and the number of containers could have been increased, but the present arrangement was found to give satisfactory results. The apparatus should be slightly heated during operation. It is also recommended to heat the cement slightly, as the finest particles cling easily to the spraying plate, the propeller and the cover. During separation the cover of the apparatus should be lightly tapped with a wooden hammer to prevent the dust from sticking to the cover. Upon completion of the separation the coarsest particles are found in the outer containers, the finer near the center. Repeated passing of the sample through the apparatus is not recommended, as the centrifugal action and the friction between the particles result in a grinding process. As the particles are already partly broken up in the original grinding process and their fragments stick together but loosely, they may easily disintegrate further by repeated centrifuging. To establish the extent of this grinding action of 2-kg. sample of cement, previously passed through the 4900-mesh sieve, was centrifuged. Four fractions were collected and the amount in each determined. The fractions are separated mainly according to size. As portland cement is a uniform product, with not more than 3% foreign admixtures, the difference in the specific gravity of the latter need not be taken into account. The individual fractions show the characteristic properties with regard to color, specific gravity and weight per unit volume.



Centrifugal apparatus for making fine separations of portland cement particles

Ten original samples as well as their individual fractions were analyzed. Their weight per unit volume and their specific gravity were determined and standard tensile tests were made. The size of the different fractions was measured by means of a microscope. It was established that adjoining fractions contained particles of equal size, but the average size showed a uniform decrease towards the center of the apparatus.

Particle Analysis of Rotary Kiln Cement

For the purpose of comparison the results found for one of the cements are given below:

Cement No. D — Rotary kiln clinker, ground in ball and tube mill. The residue on 4900-mesh sieve is 23.08% and the different fractions as follows: (I) 50.90%, (II) 8.92%, (III) 8.55% and (IV) 8.55%. The sizes of the individual fractions in microns are:

Retained on 4900 Mesh Per Cent	Diameter	—Fraction in Microns— I	II	III	IV
0.180	Min. particle	38.8	29.1	14.5	2.9
	Coarsest particle	54.3	48.0	38.8	19.7
	Ave. particle (in 30 measurements)	44.0	36.0	24.0	7.0

The measurements were made by placing a trace of the powder to be investigated on a slide and painting it with cedar oil. The dimensions given in the table are the average values from 30 determinations. As mentioned above, the measurements show no sharp division of the sizes, yet show sufficient separation to permit us to study the individual properties of the different sizes. It would be an extremely difficult task to obtain sharp division of such small sizes.

*Abridged translation from *Zement* (1926), 453-56, 469-71, 488-92, by M. A. Corbin, Riverside, Illinois.

By a suitable enlarging of the centrifugal it might be possible to separate the cement into 10 different sizes, yet the properties of adjoining sizes would differ but little.

The analysis of this cement and of the different fractions is given in the table below.

The analyses show that loss on ignition increases considerably with increasing fineness. This may be explained by the fact that the finer particles of cement, due to their large surface area in proportion to their weight, are more easily affected by the moisture and the carbon dioxide of the air than the coarser particles. The higher SO_3 and lime content of the finer sizes may be due to the fact that the added gypsum was very finely ground. The same may be true of the sulfates contained in the clinker, for one of the cement clinkers ground without gypsum admixture also shows a higher SO_3 content in the finest particles.

ANALYSES OF THE ORIGINAL CEMENT AND OF THE DIFFERENT FRACTIONS

	Original Portland Cement	Per Cent Retained on 4900 Mesh	Fraction I	II	III	IV
SiO_2	21.54	21.96	22.17	20.73	20.26	20.41
Fe_2O_3	3.72	3.29	3.89	3.98	4.09	3.50
Al_2O_3	7.44	7.83	7.96	6.76	6.55	7.08
CaO	59.70	62.60	61.37	60.23	60.68	59.58
$CaSO_4$	4.59	1.19	2.38	5.51	5.53	7.51
MgO	2.42	2.95	2.44	2.75	2.46	2.01
Loss on ignition H_2O	2.25	0.96	1.08	2.98	3.31	3.94
Loss on ignition CO_2	1.05	0.60	0.75	1.11	1.31	1.58
$\frac{CaO}{SiO_2 + R_2O_3}$	1.86	1.89	1.80	1.91	1.99	1.92

The setting properties were most irregular. These variations cannot be attributed to the non-uniform distribution of gypsum alone, but depend also on the inner structure of the clinker and its rate of hydration. In general, the time of set became shorter with increasing fineness, in spite of the higher gypsum content.

Of interest was the behavior of the amounts retained on the 4900-mesh sieve. Though cement D passed the accelerated soundness tests, the specimens prepared from the residue showed unsoundness. Both the tension and compression specimens disintegrated in water. The tests of the time of set of the individual fractions prove that the time of set has a close relation to the size of the cement particles. The unit weight per liter decreased considerably with increasing fineness, and the specific gravity also decreased, due to absorption of water and carbon dioxide.

Standard compression and tension tests were made at 3, 7, 28 and 90 days on the cement. The values given in Table I show the effect of size, i.e., of the fineness on the hardening properties of different fractions of the cement.

TABLE I. EFFECT OF PARTICLE SIZE ON HARDENING PROPERTIES OF PORTLAND CEMENT

		Original Sample	Amt. Ret. on 4900-mesh Sieve	Fraction I	II	III	IV
3 days—Tension	kg./sq. cm.	29.4	5.0	22.2	34.5	38.8	33.8
Compression	kg./sq. cm.	180.0	12.0	130.0	402.5	390.0	352.5
7 days—Tension	kg./sq. cm.	31.2	6.9	28.0	37.0	33.4	32.4
Compression	kg./sq. cm.	245.0	29.0	225.0	457.5	432.5	300.0
28 days—Tension	kg./sq. cm.	36.8	12.3	33.4	40.0	38.9	38.4
Compression	kg./sq. cm.	322.5	63.0	327.5	525.0	507.0	375.2
90 days—Tension	kg./sq. cm.	34.8	17.9	35.2	43.5	41.8	40.9
Compression	kg./sq. cm.	390.0	110.0	407.5	605.0	555.0	570.0

Note: To change kg./cm.² to lb./sq. in. multiply by 14.2.

The above researches agree in general with the values obtained by Prof. F. Schule and Dr. H. v. Gottrau in Zurich by means of the Gary-Lindner air analyzer (Windsichter) and could only have been amplified by the determination of unit weight and strength.

The results obtained justify the following conclusions:

1. The chemical analyses show that the sulphates contained in the clinker, as well as the gypsum added as an admixture, are contained mostly in the finest sizes.

2. Aside from this, the different sizes show a variation only in loss on ignition, which is highest for the finest fractions and decreases with increasing size.

3. The time of set is accelerated through increased fineness.

4. The unit weight decreases considerably with increasing fineness of cement.

5. Soundness is increased with increased fineness.

6. The portland cements yielded on the average the highest strengths for a size within the range of 19.70 and 36.30υ (microns).

7. The finest dust of a size less than 7υ becomes disintegrated soon after grinding, due to the action of air moisture and carbon dioxide, and therefore does not yield the highest strengths, as might be assumed.

8. The determination of the fines in cement permits conclusions to be drawn with reference to the operation of the grinding machinery.

9. The investigation of the different fractions permits us to judge the quality of production.

The experiments made with the use of the centrifugal show that it is well adapted to the separation of cement into different sizes and yields sufficient amounts of the individual sizes to permit the carrying out of every standard test.

The Rate of Hydration of the Cement Particles of Different Size

Two cements, the products of a vertical and a rotary kiln respectively, were analyzed by means of the apparatus described, upon being previously passed through the 4900-mesh sieve. The results for the rotary kiln are given in Table II.

To observe the rate of hydration, the author placed the particles of the individual fractions on a slide, covered it with a glass and focused the microscope on some one particle, whose size he then determined. The particle was then observed in polarized light and one drop of distilled water introduced under the glass. The double refraction disappeared momentarily in small particles less than 7υ, while it disappeared slowly or not at all for the coarser particles. By making observations on a large number of particles, the author established the fact that particles of the range 5 to 8υ hydrate very fast, almost immediately. The observation of larger particles is made difficult by the interference of products of disintegration. New crystalline formations appear, which surround the particles of clinker which have not yet disintegrated. After 24 hours the disintegration of particles up to 25υ was generally completed. At any rate, Fractions IV and III, as well as the greater part of Fraction II, were completely disintegrated. The water used for moistening was first freed from carbon dioxide and the glass cover was made water-tight with paraffin immediately upon introducing the drop. Particles of cement which remained undisintegrated after 24 hours continued to remain so with longer observation periods.

TABLE II. FRACTIONAL ANALYSIS OF ROTARY KILN CEMENT

	Residue on the 4900-mesh sieve	Fraction I	II	III	IV
Fractional analysis	3.00	61.9	11.30	12.50	11.30
Average particle size in individual fractions	184υ	50υ	40υ	26.8υ	5.0υ

TABLE III. SETTING TIME OF FRACTIONAL SIZES OF ROTARY KILN PORTLAND CEMENT

	Original Sample	Residue on the 4900-mesh Sieve	Fraction I	II	III	IV
Mixing Water	30%	30%	33%	36%	36%	34%
Initial Set	2hr. 30m.	2hr. 30m.	4hr. 15m.	0hr. 25m.	0hr. 20m.	1hr. 15m.
Final Set	6hr. 00m.	6hr. 30m.	8hr. 15m.	6hr. 15m.	6hr. 00m.	6hr. 30m.

Properties of Different Particle Sizes of Portland Cement

To study the behavior of the different fractions upon hardening, the author made

prism-shaped specimens of the fractions and prepared sections after 28-day hardening. The study of these confirmed the observations made on the loose cement particles. While the original sample, the residue on the 4900-mesh sieve, and Fraction I change but little, showing only a superficial disintegration of the clinker minerals, Fractions II, III and IV become completely disintegrated. Fraction IV shows an amorphous matrix, from which small crystals of calcium hydrate have separated. The thin sections of Fractions III and II also show an amorphous matrix, which, however, appears more homogeneous than that of Fraction IV and shows considerably more crystals of calcium hydrate.

Fraction I distinctly shows a larger number of undecomposed clinker minerals, some alite, but mostly belite and felite. It could be easily observed that only such particles became completely hydrated as consisted of homogeneous clinker substance. Fragments of the homogeneous clinker material become completely changed. It also seems that the alite of the cement clinker becomes hydrated more rapidly than the other clinker minerals in equal sizes. The needle-shaped crystals forming during the treatment of the cement particles with water could not be found in the hardened cement. It appears likely that the chemical composition of the cement and the method of calcination have an effect on the rate of hydration. No conclusive evidence on this point could be collected by the author.

Strength test specimens were dried by the author to different temperatures up to constant weight. He found that the temperature may be raised to 120 deg. C. without appreciably affecting the strength. On the contrary, he established that tension specimens yielded in most cases higher values than those of the standard test. A cement dried at 120 deg. C. gave the following strength values:

TENSILE STRENGTH OF 1:3 MORTAR
(In kg. per sq. cm.)

	3-day	7-day	28-day
Standard test	32.2	36.0	39.5
Dried at 120 deg. C.	48.0	42.3	42.0

COMPRESSIVE STRENGTH OF 1:3 MORTAR
(In kg. per sq. cm.)

	3-day	7-day	28-day
Standard test	234	384	486
Dried at 120 deg. C.	342	358	485

As the tests after short periods of hardening—particularly the tension tests—show a favorable effect, the author assumed that drying to 120 deg. C. does not result in decomposition of the hardened cement, i.e., that the chemically bound water does not become driven off at this temperature. The water which does escape up to 120 deg. C. is considered as pore or hygroscopic water. It may be argued that the number of the tests was too small to allow the drawing of general conclusions. It may also be the case that drying to a 120 deg. C. eliminates certain chemical compounds whose action would have become apparent after longer periods of hardening. To establish a consistent method, however, the author assumed the temperature of 120 deg. C. as the limit temperature for hygroscopic and chemically combined water. He made prism-shaped specimens from the different fractions of the two cements and cured them out of contact with the carbon dioxide of the air, in air and in water. The hygroscopic and the chemically bound water were determined at ages of 1, 3, 7, 28 and 90 days. To this end, the prisms were powdered upon hardening and dried over sulphuric acid up to constant weight. The loss of hygroscopic water was found to be highest for short periods of hardening at 60 deg. C. and became reduced for longer periods. On the contrary, the quantity of chemically bound water was small after short periods of hardening and increased considerable with longer periods. It is therefore probable that, as mentioned above, the water becomes chemically bound after long periods of hardening, but the compounds are easily decomposed at low temperatures.

These results do not agree exactly with the microscopic observations. According to the latter, the contact of the finest particles with water results in an immediate or rapid alteration of the cement particle. On the other hand, chemically bound water increases only upon prolonged hardening.

It may therefore be assumed that only the finest particles become hydrated immediately, which also appears correct from the higher water content of Fractions III and IV. According to investigations made by Michaelis and Feichtinger, a recently set cement loses its entire water at 250 to 300 deg. C. The present observations do not agree with this statement. The tests were made 12 hours after making the specimens. It is to be assumed that Michaelis and Feichtinger made use in their tests of the coarsely ground cements then in use. These had very few fine particles and could not contain much chemically combined water.

The rapid hydration of the finest cement particles depends upon the large surface area of the latter. For example, 1 c.cm. of cement particles of 1υ diameter, imagined as spheres, presents a total surface of 3.14 sq.m., whereas the same volume with particles of 10υ diameter presents only 0.315 sq.m. This explains the cause of rapid hydration.

The results of the author's investigations on the rate of hydration of cements may be summarized as follows:

Conclusions

1. Hydration is the result of the action of water on the surface of the cement particles. The rate of hydration increases with the rapidly increasing surface area of decreasing sizes.

2. Cement particles of 15 to 18υ hydrate completely, i.e., nearly all the clinker minerals become altered. Coarser particles hydrate only in part.

3. The rate of hydration depends also on the properties and the chemical composition of the clinker minerals. Alite hydrates considerably faster than the other clinker minerals.

4. The rate of hydration depends also on the size of the clinker crystals. A single crystal of 15υ diameter hydrates more rapidly than a particle of similar size made up of different clinker minerals.

The Syrian Cement Market

SYRIA offers a good market for portland cement, says the *Tonindustrie-Zeitung*, for despite the large increase in building, there are as yet no cement mills in the country. New structures and extensive additions to older buildings are under way in the principal cities, Beirut, Damascus, Aleppo and Tripolis. But this activity is not confined entirely to the cities, for the outlying farm districts are using a good share of the imported cement for various purposes.

The imports of cement have increased from 3329 tons in 1913 to 31,235 tons in 1924. Figures for 1925 and 1926 are not available but are expected to be above those of 1924. The greater part of the cement comes from France, Italy, Germany and Belgium and usually is entered at Bierut for distribution. Since much of the hauling is done by donkeys and camels, the 50 kg. (110 lb.) sack is preferred to the 180 kg. (396 lb.) barrel. The French franc is the standard for payment, 20 francs being equal to one Syrian pound. The usual shipping terms are cash against bills of lading, but sometimes 60 to 90 days' credit is given to established dealers. Import duties vary from 11 to 15% ad valorem, dependent on the country of origin. The Syrian purchaser is usually governed by the price of the cement rather than its quality, the report states.

Canadian Blue Talc Deposit To Be Developed

TORONTO capital will develop the only known blue talc deposits in Canada, a big bed located about ten miles southwest of Banff, Alberta. A private company, adequately financed, has been organized by W. H. Matthews of that city and development operations will be started as soon as weather and trails permit. White talc deposits are also found in association with the blue. The latter is the more valuable, as it is in great demand for use in electrical machinery and equipment.

Canada does not possess a plant that can handle blue talc, and the product will be shipped clear to Tennessee for treatment.

The white talc will be sold in Canada, as there are many industries that can utilize it, particularly those which manufacture face and other toilet powders.

The blue talc is rare. The Banff deposits were discovered through the activities of Canadian Pacific Railway investigators.

Crushing Granite at Raleigh, North Carolina

Raleigh Granite Co. Operation Typical of Granite Quarrying Methods in the Locality

THE Raleigh Granite Co. is one of the enterprises of Robt. G. Lassiter and Co., a large contracting firm of Raleigh, N. C. It owns several quarries and is operating four at the present time. Its output record is 60 cars per day, shipped in 1926, said to be the highest for any quarry operation in the state. Conditions in this section of the country make it more profitable to run a number of small quarries rather than to run one large quarry and ship to distant points.

Quarry Operations

As with other granite quarries, the work has gone downward vertically rather than horizontally. Granite, being an igneous rock, does not lie in deposits like limestone. It is in intrusive forms, such a dikes and locoliths, which have pushed up through the older rocks. Such formations usually go to profound depths and as they are not water-bearing only surface water has to be contended with in working them. Hence the tendency is to sink the quarry deeper rather than to extend the face.

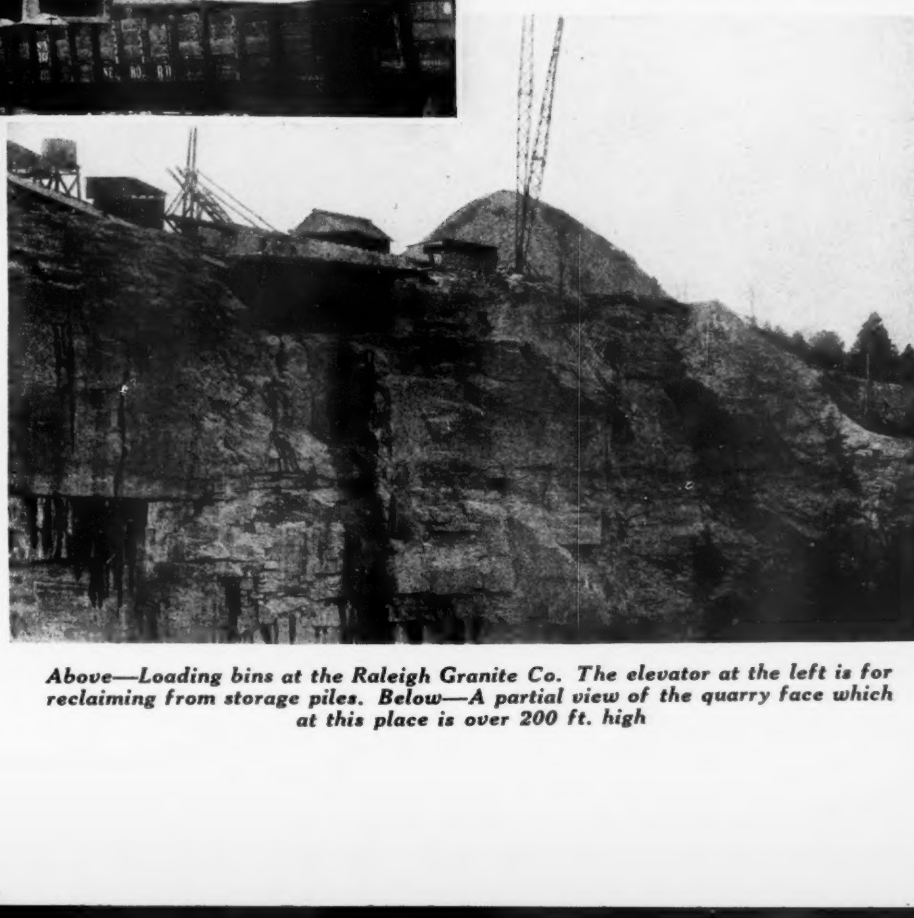
At present derricks are used to lift the skips of stone from the quarry to the crushing plant, but it is planned to change this scheme of operation and load motor trucks with a steam shovel. The trucks will run up an incline from various benches in the quarry to the primary crusher.

The reason for making a change, according to J. H. Champion, the superintendent, is that derricks are slow and expensive to operate. There are three in use, each with its own engine and hoist man. The pans which are hoisted have to be loaded by hand and this is more expensive than the steam shovel loading that would be used with trucks. And the ground would be worked by well drill holes which requires less labor than the tripod-drilling now used in the bottom of the quarry.

It is planned to work the quarry in three benches, 75 ft., 55 ft. and 40 ft. in height, and a Sanderson-Cyclone well drill was putting down holes for the upper bench when the quarry was visited recently. The rock is hard and the drill averages about 10 ft. per day. But the rock breaks well. Holes are loaded about two-thirds of their depth with 60% DuPont powder. Some pop shooting is required and 40% power is used for this.

At the time the quarry was visited, work was going on at the bottom. This was taken out in three lifts. Holes were put in by X-70 Ingersoll-Rand tripod drills to a depth of 18 ft., and the broken stone was loaded into pans holding four tons. The pans were made for the company by the Gibbs Machinery Co. of Columbia, S. C.

These pans are hoisted by three derricks for 200 ft. and then swung to the primary crusher. A workman then uncouples the chains on the front of the pan and the derrick man lifts on the rear chains and thus pours the contents of the pan into the crusher. The front chains are then hooked



Above—Loading bins at the Raleigh Granite Co. The elevator at the left is for reclaiming from storage piles. Below—A partial view of the quarry face which at this place is over 200 ft. high

on and the pan lowered to be loaded again.

The derricks, made by the American Hoist and Derrick Co., all have 70 ft. booms and will lift five tons when the boom is extended horizontally. The engines are all of Lidgerwood make, two with 9x10 cylinders and one with 10x12 cylinders. They are steam driven, although the plant machinery is electrically driven. But for hoisting work under such conditions steam is preferred and has been found to be more economical.

The primary crusher is a 32x40-in. Farrell (Earle C. Bacon) jaw crusher and it is set below the ground level with a wide platform around it to give space for handling the pans. It is driven by a 150-hp. Allis-Chalmers electric motor.

When stone is taken from the upper workings it is brought in on 6-yd. cars which were made by the company. These have a very simple method of dumping. At the end of the track the rails curve up sharply so that the car is up-ended to the dumping position. A cross bar projecting beyond the end door on each side strikes rails which lift it as the car is pulled up, allowing the stone to run out. The cars are pulled up an incline by a Lampert hoist converted from steam to electric drive. This part of the operation was being revised when the plant was visited and the work was not completed. (It will be described later.)

The discharge of the primary crusher goes by a chute to a 36-in. belt of 188 ft. centers which conveys it to the upper part of the plant. The belt discharges directly into a No. 7½ Allis-Chalmers crusher driven by a 100-hp. Allis-Chalmers motor. The crusher discharge is lifted by a 30-in. bucket and belt elevator of the close connected type to a screen 32 ft. long and 60 in. in diameter made by the Good Roads Machinery Co. Both elevator and screen are driven by a 60-hp. Allis-Chalmers motor.

Pan with load of stone from bottom of the quarry dumping into the crusher

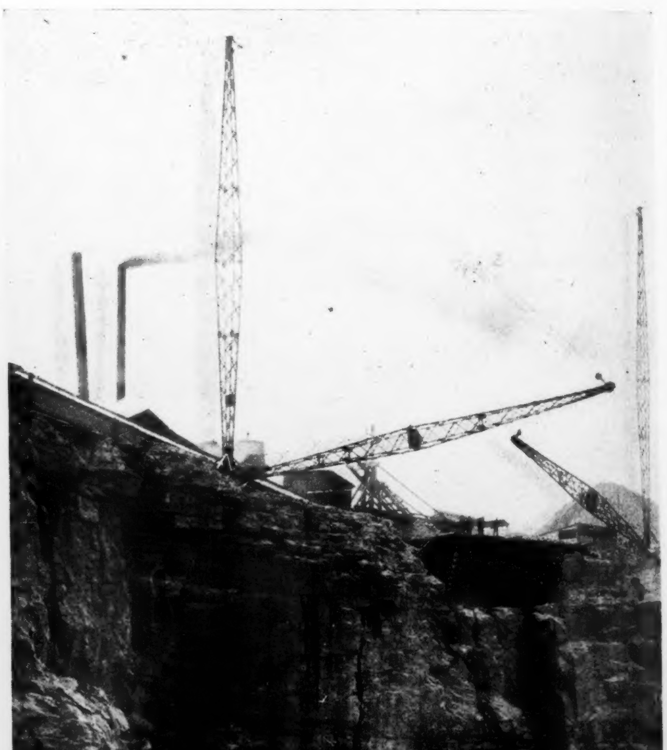
The oversize of the screen falls through a chute to two crushers, a No. 6 McCully and a No. 18 direct drive Weston. The chutes are arranged so that either or both of these crushers may be operated and the discharge goes to the same elevator that lifts the discharge of the No. 7½ crusher. The Weston crusher discharge has to be handled by a short elevator in order to do this.

The screen has 2¼-in., 1½-in. and ¾-in. perforations. The larger sizes go directly to bins. The smallest size is run over a 6-ft. Hum-mer screen that makes a ¾-in. to ⅜-in. size and screenings. These screenings are sold for bituminous-type road work and for making "Catchinite" roads, a form of oil-bound highway. Occasional sales are made for use as fine aggregate in concrete and a little is used by the railroad as ballast.

Bins and Storage

The bins are all of concrete and hold 14 cars. When the bins which hold the larger sizes are filled the overflow runs through a chute to the storage system. This is a very simple and effective arrangement which uses a Sauerman scraper bucket of the Crescent type to build a storage pile of the crushed

The three benches in the bottom of the quarry. Holes are put in with tripod drills



Three of the four derricks used to lift pans of stone to the crusher

Storage bucket filling at the overflow chute

Crescent-shaped bucket building a stock-pile

rock and to recover it when it is needed.

The bucket has about 100 ft. run and at the end of its path is the mast on which the sheave is hung. A Lampert hoist, converted from steam to electricity, handles the cable. The bucket takes its load from a pile at the bottom of the overflow chute and draws it out on to the pile. After the pile is built, the stone may be reclaimed by merely reversing the bucket. Then it draws the rock back to a point near the loading point where it discharges into the boot of a bucket and belt elevator. This elevates it back to the bin from which it came originally so that it can be loaded from the bin into cars in the usual way.

From the very nature of the material from which it is made, the product of this plant is bound to be of excellent quality. It is all hard, tough granite, excellently adapted for ballast, concrete aggregate and highway materials. Many miles of the famous North Carolina roads have been built of it, both of concrete slab and "black top" construction.

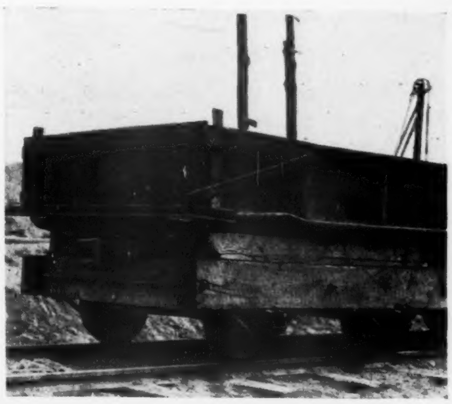
The foregoing description is but a brief resumé of the quarry practice of a typical North Carolina crushed granite producer. It refers only to the Greystone plant of the company. A more general description of the operations will appear in a later issue.

Track from upper workings and car dumper

Quarry Safety Conference Holds Interesting Meeting at Toledo

WITH E. E. Evans, Whitehouse Stone Co., Toledo, Ohio, presiding as chairman, the Quarry Safety Conference was held April 8 at the Secor Hotel, Toledo. A considerable contingent of quarry men from the middle west were present.

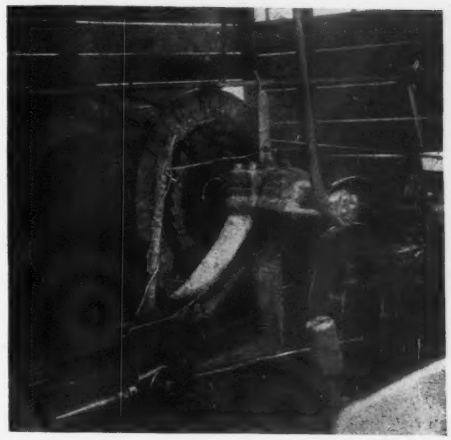
D. W. Yambert, electrical engineer, France Stone Co., gave a very interesting and constructive talk concerning electrical hazards. He closed by saying that



Type of car used in upper workings

the France organization was fitting individual motors with interlocking switches which automatically take care of the flow of material through the mill in case of breakdown or repairs of any sort.

E. R. Cartwright, Mid-West Crushed Stone Co., Indianapolis, Ind., presided at the afternoon session. After a movie of explosive engineering activities, produced through the courtesy of the Hercules Powder Co., J. Barab, Hercules Powder Co., Wilmington, Del., read a splendid paper called "Cost Reductions Through Accident Prevention." Jay M. Thompson followed Mr. Barab; he gave a demonstration of finger shut-offs for artery cuts and resuscitation, and asked that more attention be paid to demonstrating safety so as to establish customs automatically protecting employes from danger.



Type of hoist operating the derricks

I. R. McClarren, safety agent, New York Central railroad, Toledo, Ohio, spoke of the excellent work his company is doing in reducing accidents, attributing the amazing results to the fine co-operation between employer and employes.

This was one of a series of safety meetings, covering the rock products industries, which have been held in various parts of the country recently, under the auspices of the National Safety Council.

Well drill putting down holes in the upper workings

Some Notes on Portland Cement Manufacture

A Comparison Between Products of Dry and Wet Processes of Manufacture in Australia

By Walter J. Pitt
Maria Island, Tasmania, Australia

IN the following the chemical and physical tests have been carried out as far as permissible with a limited amount of equipment. This paper is presented merely to enable readers and cement mill operators to compare the data obtained with their own records. The briquettes are all handmade unless otherwise stated, using British standard brass molds. In every test three briquettes were made and the average of three recorded as the mean tensile strength. On page 82, August 7, 1926, issue of ROCK PRODUCTS, under the heading "Relation of Fineness of Cement to Strength," there are given two ways in which the quality of a cement may be improved. In the first place the lime content may be raised; this was done in the case of W. P. 1 and the Le Chatelier expansion test made on the fresh cement from mill, 24 hr. old, gave 30¼ mm. and after aging for 28 days the same cement showed only 2¼ mm. This physical change has a marked effect on the tensile strength with a temporary increase ranging from 10% to 60% at 28 days (sanded mortar, 3:1). This plan is not to be recommended for cement that is required to be stored before using and unwise from a practical point of view, as results show that it is not a good keeping cement and would cause considerable complaint. A typical example is appended below:

28-DAY STORAGE IN CONCRETE SILO

Neat cement	550 lb. per sq. in.
Mortar (3:1)	200 lb. per sq. in.

SIX-MONTH STORAGE IN GALVANIZED IRON SHED

Neat cement	290 lb. per sq. in.
Mortar (3:1)	95 lb. per sq. in.

Portland cement when ground extra fine has disadvantages, particularly when hand-worked with the shovel. Also there is a tendency for fine cement to become lumpy; this causes extra work to rub down the lumps. For the portland cement manufacturer a finer product increases grinding costs, cuts down output and increases cost for loading.

The table below gives the analyses of seven portland cements made in a rotary kiln using the wet process of manufacture.

MODULI

Sample	$\frac{CaO}{SiO_2+R_2O_3}$	$\frac{SiO_2}{R_2O_3}$	$\frac{Al_2O_3}{Fe_2O_3}$
A	2.01	3.6	......
B	1.94	3.06	3.7
C	1.948	3.70	2.51
D	1.954	3.88	3.60
E	1.97	3.04	3.26
F	1.912	3.42	2.94
G	1.934	3.70	2.73

Wet Process

The following tests were carried out on cement made from a combination of crinoid limestone and fossil rock. The quantities are not weighed, neither is clay added to the slurry. The $CaCO_3$ in the mix is maintained at 77.3%. The two varieties of limestone are milled into separate correction basins of 247 cu. ft. capacity for adjustment.

The exact amount of each basin is calculated to give a mix containing 77.3% $CaCO_3$.

ANALYSIS

Fossil Rock	per cent	Crinoid Limestone	per cent
SiO_2	21.1	SiO_2	15.4
Al_2O_3	3.98	R_2O_3	1.36
Fe_2O_3	1.22	$CaCO_3$	80.84
$CaCO_3$	70.40	$MgCO_3$	1.40
$MgCO_3$	2.52	Organic, etc.	1.00
Organic, etc.	0.78		
	100.00		100.00

The analysis of the finished cement is appended here; its features are slow setting, with high tensile strength on the briquettes boiled for 6 days.

ANALYSIS OF FINISHED CEMENT

	per cent
SiO_2	26.49
Al_2O_3	4.88
Fe_2O_3	1.81
CaO	62.72
MgO	1.03
SO_3	1.72
Loss	1.30
	99.95

RATIO OF BASES TO ACIDS

Chemical Equivalents:

$$\frac{CaO+MgO}{SiO_2-(Al_2O_3-Fe_2O_3)} \quad \frac{\text{Bases}}{\text{Acids}}$$

$$=\frac{\frac{62.72}{56}+\frac{1.03}{40}}{\frac{26.49}{60}-\frac{4.88}{102}-\frac{1.81}{160}}$$

$$=\frac{1.12+0.25}{0.44-.048-.011}=\frac{1.145}{.381}=3.00$$

Ratio = 3.

According to Le Chatelier's formula, this ratio should fall between 3.5 and 4.0 to give a good cement. It is not always possible to apply the formula, owing to variation of composition and character of raw materials available. Cement manufacturers are therefore compelled to slightly deviate from the formula to suit local conditions. Several test pats were made from the cement fresh from the mill and when hard-set, 24 hours after making up, were boiled for 24 hours; they were then removed from hot plate and allowed to thoroughly cool off. There were no signs of convex or concave warps, checking or radial cracks; all the pats were sound. No water was applied to the clinker after leaving the kiln, and it was fed direct into the cement mill. (Residue on 180² mesh sieve means 32,400 meshes per square inch, or 180 meshes per lineal inch.)

The following data are the results of physical tests made on neat and mortar briquettes placed under the water and broken at the end of schedule time:

3 days		7 days cold	
Sand	Neat	Sand	Neat
125	441	220	587
7 days hot		**28 days**	
Sand	Neat	Sand	Neat
350	870	344	867

It is interesting to note the gradual in-

WET PROCESS—PERCENTAGE COMPOSITION

Sample	SiO_2	Al_2O_3	Fe_2O_3	R_2O_3	CaO	MgO	SO_3	Loss on Ignition	Date When Milled
A	24.5	......	......	6.80	63.10	......	1.57	1.60	June, 1926
B	25.44	5.08	1.86	6.94	62.80	1.06	1.80	2.00	July, 1926
C	25.49	4.93	1.96	6.89	63.10	1.17	1.78	1.30	Aug. 1926
D	25.59	4.78	1.81	6.59	62.90	1.21	1.84	1.86	Sept. 1926
E	24.20	6.08	1.86	7.94	63.32	1.10	1.85	1.40	May, 1926
F	25.44	5.54	1.88	7.42	62.84	1.10	1.78	1.45	April, 1926
G	25.68	5.08	1.86	6.94	63.11	1.24	1.72	1.20	Mar. 1926

crease in strength, and no tendency to fall off after 7 days. The residue on a 180^2 sieve was 6.5% and on the 100^2 sieve 0.3%. The same results, practically, were recorded when the cement was fine ground so that all cement passed the 180^2 sieve. Some writers are obsessed with the belief that the finer you grind the cement, the stronger its gets. Sample W. P. 1 was subjected to this test. In practical cement manufacture tests recorded show that the maximum strength was reached when the cement was ground so fine that 7% residue remained on the 180^2 sieve.

Dry Process Tests

Plant superintendents are often in doubt as to whether the addition of waste materials would be detrimental to the finished cement. The following experiment carried out with materials listed below gave good results:

Upper marine shale	200 lb.
Limestone	2,244 lb.
Flue dust	200 lb.

These quantities made up a charge for the kiln. The resulting clinker was allowed to aerate for 28 days, then pulverized into cement. The setting was considerably sharp, so an excessive quantity of gypsum had to be added to retard the set. (This cement is designated as No. X in the following tables.)

Physical testing carried out gave the following:

PHYSICAL TESTS ON CEMENT NO. X

Residue 120^2	Residue 200^2	Setting Time Initial hr. m.	Setting Time Final hr. m.	Neat Cement Tensile Strength 7 days Cold	Neat Cement Tensile Strength 7 days Hot	Soundness	Expan. Le Chat.	Tensile Strength Sand, 7 days Cold	Tensile Strength Sand, 7 days Hot	Tensile Strength 28 days Neat	Tensile Strength 28 days Sand
6.5%	18.0%	3:15	6:00	1300	1100	O.K.	2.5 mm.	400	375	1400	500
				1300	1000	O.K.	2.5 mm.	400	325	1400	450

COMPRESSIVE STRENGTH

Air		Water	
7 days water	5650 lb.	1 day air	4150 lb.
21 days air	5300 lb.	27 days water	4150 lb.

ANALYSIS CEMENT NO. X

Water used for mortar briquettes = 8.5%
Water used for neat briquettes = 17.5%

	Per cent
SiO_2	21.30
R_2O_3	8.20
CaO	64.40
MgO	2.30
SO_3	2.60
Loss	1.20
	100.00

The above briquettes and cubes were made by the Bohme mechanical hammers.

Five samples of cement from five different portland cement plants in various parts of Australia were placed under test. Each sample was mixed with 25% water by weight and made into test pieces, 30x30 mm. Specific gravity dry cement 3.125.

The dry process portland cements become much more dense on boiling those made by the wet process. It is of interest to note that the hot tests at 7 days are lower than the cold test, as far as tensile strength is concerned. These cements have earned the reputation of being a high grade portland cements although much has been left to chance rather than science.

It has been proved conclusively that the quality of the testing sand exerts a great influence in the tensile strength, so much

SPECIFIC GRAVITIES OF DIFFERENT CEMENTS

	Unboiled, set in air, then H_2O 7 days Sp. Gr.	Set under water 24 hours, then boiled 6 hours Sp. Gr.	Set under water 24 hours Sp. Gr.
W. P. 1	2.223	2.220	2.219
D. P. 2	....	2.290	....
D. P. 3	....	2.250	....
W. P. 4	....	2.175	....
W. P. 5	....	2.021	....

Note: W. P. = Wet process. D. P. = Dry process.

so that cement mixed with good sand in the same proportions will show a strength on testing as much as 65% greater than an inferior grade.

Sand for physical testing of portland cement was selected by the following standard method in vogue in Australia:

ANALYSIS OF TESTING SAND

	Per cent	
SiO_2	89.12	
R_2O_3	8.40	(Fe_2O_3 as Hematite)
CaO	0.80	
Organic, CO_2, etc.	0.51	
Not determined	1.17	(Muscovite; mica)

Nepean River sand is washed and dried, passed through 20^2-mesh sieve and the throughs passed to a 30^2-mesh sieve. The residue on this sieve is used in the mortar tests.

Nepean River sand is located on the river bed, deposited by storms during the wet seasons. In dry periods, there is just a trickle, allowing reclaiming. The site is situated about 35 miles west of Sydney on the Western railroad. This is a standard sand and used extensively by portland cement manufacturers in Australia. Although there are better testing sands to be had in other countries, the Nepean sand is the next best available. I have used several grades of sands for testing cement but the former is generally accepted for its regularity and cleanliness. In carrying out of practical work it is better to err on the safe side and have the sand clean.

Silica in 1925

THE total production of silica materials, including tripoli and diatomaceous earth in the United States during 1925, amounted to 391,843 short tons valued at \$3,419,806 as compared with 345,832 short tons valued at \$2,941,559 produced in 1924, according to statistics recently received by the Bureau of Mines, Department of Commerce. This represents an increase of 7% in quantity and 16% in value in 1925 over the output in 1924.

Crude and crushed quartz were sold or used by producers in 1925 in 12 states. The western states, Wisconsin included, produced about 53% of the total. The rest came from Atlantic coast states. The total output reported was 12,746 tons valued at \$287,019. Prices for crude ranged from \$1.50 to \$9.19 per ton, with an average of \$4.37 f.o.b. mines and ground quartz sold at \$17 to \$37, average \$22.52 per ton f.o.b. mines.

Ground sand or sandstone amounting to 263,981 short tons valued at \$1,857,263 was sold by producers in eight states. Values per ton ranged from \$4 to \$10.37, with exceptional values of \$30 per ton and an average of about \$7 per ton.

COMPARATIVE DATA ON WET AND DRY PROCESS PORTLAND CEMENTS

	W. P. 1 Init.	W. P. 1 Final	D. P. 2 Init.	D. P. 2 Final	D. P. 3 Init.	D. P. 3 Final	W. P. 4 Init.	W. P. 4 Final	W. P. 5 Init.	W. P. 5 Final
Setting test	3:15	5:0	1:00	4:30	2:30	4:30	3:30	6:15	3:0	4:15
Residue 180^2	3.4%		16.0%		12.0%		4.0%		3.2%	
Gaging water for briquettes:										
3:1	9.0%		8.5%		9.0%		9.0%		9.0%	
Neat	18.0%		16.0%		16.5%		18.0%		20.0%	
Le Chat. Expan.	2¼ mm.		2 mm.		2 mm.		2¼ mm.		1¾ mm.	
Briquettes, lb./sq. in.:										
1 day 3:1	84		70		99		101		151	
1 day neat	394		474		367		306		456	
2 days 3:1	153		153		189		168		221	
2 days neat	597		701		597		552		671	
3 days 3:1	230		245		221		263		344	
3 days neat	672		800		732		705		733	
5 days 3:1	280		......		......		......		......	
7 days 3:1	342		365		368		357		403	
7 days neat	807		982		936		882		827	
7-day Hot Test:										
7 days 3:1	554		400		393		420		426	
7 days neat	990		912		878		827		765	
28 days 3:1	518		464		475		473		478	
28 days neat	975		892		888		856		895	

Hints and Helps for Superintendents

Special Cars for Shipping Crushed Stone

THE Seaboard Airline railway has a number of granite quarries on its line through the Carolinas and it appreciates their business so much that it has introduced a special type of car for shipping crushed stone. It is a solidly built steel car, differing principally from other open top cars in its dimensions. These are such that it may be loaded with 50 tons of crushed stone, but it cannot be loaded with 50 tons of coal. The sides would have to be higher to contain such a load.

These cars were adopted by the Seaboard railway at the request of some of the quarrymen who use the line, and they have been a great success. As they are suitable only for stone shipments, they are returned promptly and the danger of a car shortage is lessened.

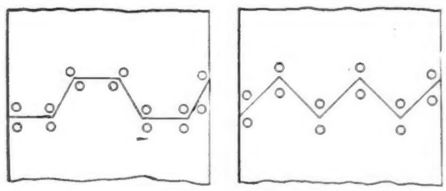
The car shown here is at the quarry of the Weston & Brooker Co., at Cayce, a suburb of Columbia, S. C.

Specially built car for shipping crushed stone

Lagging a Slippery Pulley

SLOW-SPEED cast-iron pulleys subject to work of a heavy nature are often found to be slipping too much for the load intended. At times the belt will slip off, or at least to one side, diminishing the belt bearing surface and aggravating the trouble. The lining or lagging of the pulley by means of a piece of rubber belting which covers the entire rim is better than an excess of belt dressing.

The best practice is assured by fitting the ends of the lining along a zigzag line as indicated in the accompanying illustration. A straight line joint will cause one end to roll back a trifle under the strain and make a ridge across the pulley rim, which is not wanted. To prevent the buckling up of the lining and to have a snug fit, elevator bolts



Alternative methods for jointing rubber belt pulley lagging

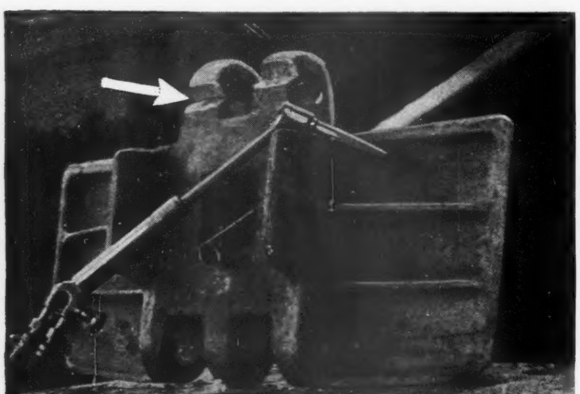
must be placed every 6 or 8 in. in every direction.—By Charles Labbe, Clarkdale, Ariz., in *Engineering and Mining Journal.*

Repairing Broken Caterpillar Tread Links by Welding

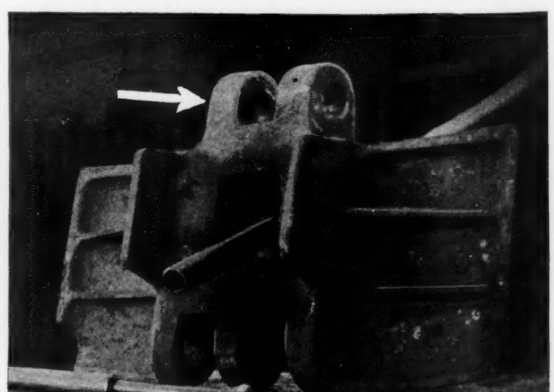
AN interesting example of how material relegated to the scrap heap may be reclaimed and put into operation again economically is reported in a recent issue of *Oxy-Acetylene Tips.* In the junk-pile of a midwestern company lay the broken pieces of three caterpillar tread-links. These were steel castings of the type which when linked together formed a roller similar to that used on war tanks.

One of the company workmen undertook to repair the broken parts, using an oxy-welding apparatus. The job presented no unusual difficulties and was accomplished in less than five hours. The total cost of repair based on local conditions was said to be about $12. Itemized, this covered 150 cu. ft. of oxygen, 135 cu. ft. of acetylene, 30 min. preparation, four hours welding and 8 lb. of welding rod. The cost of replacement of the steel castings with new ones was said to be $60. Consequently a saving of $48.45 on this small job resulted.

The accompanying illustrations show the casting before and after welding. In the center of the left-hand view can be seen the three lugs drilled for the connecting pins, the arrow point out where repair work was necessary. The arrow in the right-hand view shows the finished appearance of the casting after welding had been completed.



Saved from the junk pile and made sound for $12—representing a saving of $48 over the cost of new parts

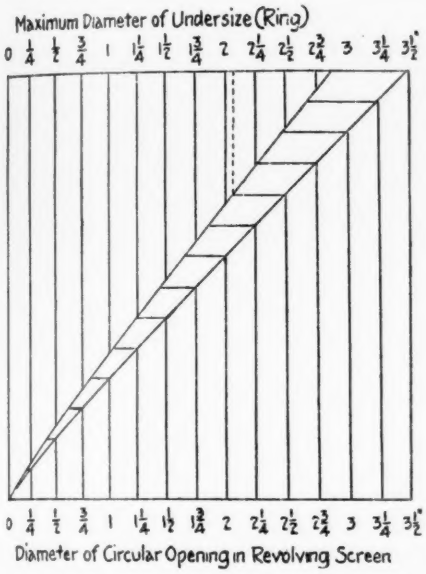


Caterpillar tread links repaired by welding. At the left is shown the casting ready for welding and the right hand view shows the weld completed

Relation Between Revolving Plant Screens and Laboratory Screens

A. T. Goldbeck
Director, Bureau of Engineering, N. C. S. A.

THE size of crushed stone is generally stated in terms of laboratory screens, sometimes with square openings, sometimes with round openings. A revolving plant



Graph showing the relation between rotary plant screens and laboratory screens

screen with round openings of a given size does not produce material of that same size measured by a laboratory screen, and the producer should, therefore, be interested in knowing what relation exists between the size of opening in his plant screen and the maximum diameter of particles produced by that screen. This relation for round opening in both revolving and laboratory screens is stated in U. S. Bureau of Mines Bulletin No. 234, page 73, as follows:

Diameter of round hole perforation in revolving screen	Maximum diameter of undersize (ring)
½	⅜
⅞	¾
1¾	1 7/16
3½	2⅞
7	5¾

The above table is shown graphically in the illustration accompanying. With reference to the graph it can be easily seen that a 2½-in. circular opening revolving screen may be expected to produce material having a maximum size of 2 1/16 in. and which should pass through a 2⅛-in. ring.

Bridge Which Carries Storage Across Railroad Tracks

THE Dixie Sand and Gravel Co. at Chattanooga, Tenn., although it has an unusually large storage capacity in its bins, recently felt the need of increasing the storage space. The plant is built between the river and the railroad tracks and the only ground available was on the other side of the tracks.

To reach this a steel bridge was built over the tracks and out into the proposed storage yard. This bridge carries a 24-in. conveyor which can discharge at any point in its length by means of a tripper.

The material to be stored is placed in a hopper at the plant end by an electric locomotive crane. It was easy to load in this way at the Dixie plant, because a crane is always in service transferring material from the plant bins (which load directly into railroad cars) to truck loading bins. The hopper for the bridge is so placed that the crane can load into it from any bin without moving.

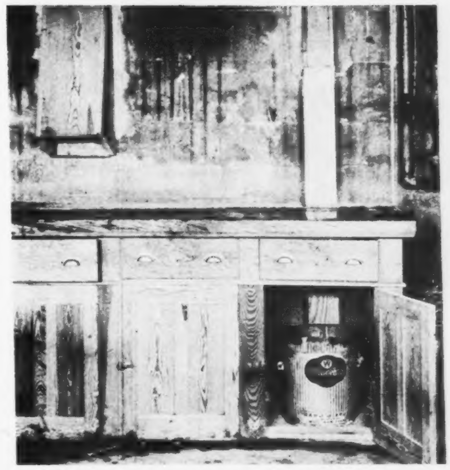
The stockpiles are loaded out for truck delivery by a small locomotive crane powered with a gasoline engine.

Steel bridge built over railroad tracks and out into storage yard. The bridge carries a 24-in. conveyor belt which can discharge at any point along its length

A Laboratory Hint

TAKING care of the debris that comes from testing in the physical laboratory of a cement plant usually involves some work which may be saved in part by the device shown here. This is in the cellar under the physical testing laboratory of the Cumberland Portland Cement Co. at Cowan, Tenn. The square chute shown runs down from a hole in the bench above, and when the "lab man" has any accumulation of waste material on the bench he brushes it into the hole and goes on with his work.

A 50-lb. garbage pail under the chute catches everything and this is emptied every morning before he begins. As the pail is in a closet under a bench, no dust escapes into the room. The bench is part of the equipment of the grinding room in the cellar where samples are prepared.



Chuting laboratory debris to the waste bucket

Handling Clay in Crushers

STICKY CLAY interferes with the regular operation of rock crushers and entails extra labor to work the clayey material through the crusher. At cement mills the difficulty is partly overcome by sprinkling fine dry mix in the throat of the crusher before the clayey material is fed. This prevents sticking, on the same principle that prevents dough from sticking when it is coated with dry flour. Fine tailings will answer the purpose in crushing plants.—*Engineering and Mining Journal.*

Portland Cement Output in March

Production and Shipments Above Last Year—Stocks Greatest in History of Industry — Quarterly Records Established

MARCH production and shipments of portland cement were the greatest for that month in any year, according to the Bureau of Mines, Department of Commerce. Production shows an increase of over 10%, and shipments an increase of more than 16%, as compared with March, 1926. Portland cement stocks at the end of March, 1927, are 3% in excess of the stocks at the end of March, 1926, and are the greatest at the end of any month in the history of the industry.

Production and shipments of portland cement for the first quarter of 1927 show increases respectively of 4 and 13% over the corresponding period in 1926.

The output of a new plant, located in Alabama, is included for the first time in these statistics, which are prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines and are compiled from reports for March, 1927, received direct from all manufacturing plants except five, for which estimates are necessary on account of lack of returns.

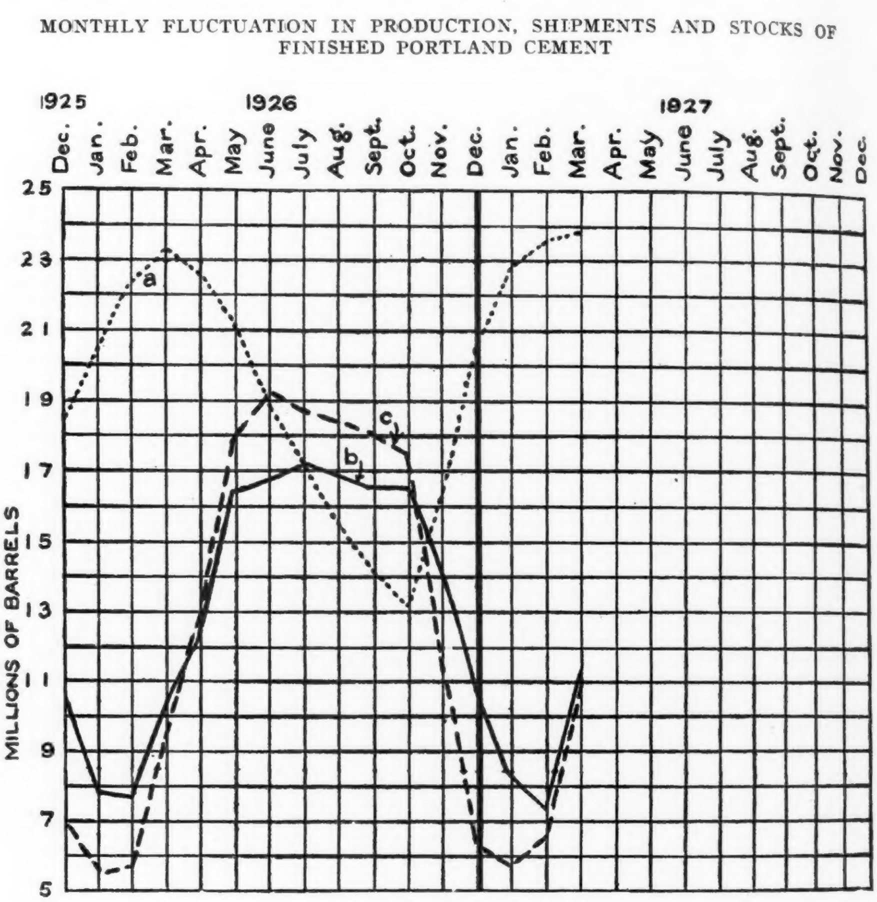
Stocks of clinker, or unground cement, at the mills at the end of March, 1927, amounted to about 13,003,000 bbl. compared with 11,943,000 bbl. (revised) at the beginning of the month.

ESTIMATED CLINKER (UNGROUND CEMENT) AT THE MILLS AT END OF EACH MONTH, 1926 AND 1927

Month	1926	1927
January	9,074,000	9,989,000
February	10,931,000	*11,943,000
March	12,290,000	13,003,000
April	12,967,000	....
May	11,695,000	....
June	10,144,000	....
July	8,604,000	....
August	7,362,000	....
September	6,112,000	....
October	5,370,000	....
November	5,748,000	....
December	7,799,000	....

*Revised.

MONTHLY FLUCTUATION IN PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT



(a) Stocks of finished portland cement at factories. (b) Production of finished portland cement. (c) Shipments of finished portland cement from factories

Distribution of Cement

The following figures show shipments from portland cement mills distributed among the states to which cement was shipped during the months of January and February, 1926 and 1927:

PORTLAND CEMENT SHIPPED FROM MILLS INTO STATES IN JANUARY AND FEBRUARY, 1926 AND 1927, IN BARRELS*

Shipped to—	1926—January	—1927	1926—February	—1927
Alabama	129,291	132,569	145,636	127,020
Alaska	165	0	264	132
Arizona	38,869	54,088	28,956	41,677
Arkansas	46,708	46,014	55,984	59,309
California	931,238	998,230	714,783	649,302
Colorado	29,203	28,050	51,068	45,006
Connecticut	40,300	34 587	29,323	58,534
Delaware	9,019	11,170	6,437	13,885
District of Columbia	35,304	50,552	47,086	59,964
Florida	483,824	283,031	445,674	285,604
Georgia	80,129	119,770	86,417	134,787
Hawaii	10,757	22,491	15,830	31,022
Idaho	19,198	15,085	19,524	27,495
Illinois	323,947	301,829	429,654	417,054
Indiana	85,724	74,589	121,253	143,650
Iowa	28,439	38,157	50,077	55,837
Kansas	56,598	68,122	114,296	107,823
Kentucky	35,560	42,851	56,249	78,183
Louisiana	65,695	116,633	84,706	122,629
Maine	20,310	6,295	19,084	5,422
Maryland	85,495	135,015	77,537	123,421
Massachusetts	101,212	70,354	57,390	81,457
Michigan	222,061	258,848	253,661	301,666
Minnesota	66,063	41,396	72,714	61,047
Mississippi	44,140	51,325	47,179	62,783
Missouri	137,343	113,581	202,914	173,365
Montana	9,716	7,261	9,867	9,845
Nebraska	23,788	22,675	49,054	39,594
Nevada	2,508	2,724	5,754	3,649
New Hampshire	17,081	16,172	12,750	9,599
New Jersey	257,544	277,489	163,588	279,739
New Mexico	12,019	12,503	14,308	20,957
New York	592,584	†700,414	434,323	855,484
North Carolina	81,764	141,582	139,656	168,720
North Dakota	3,338	3,575	4,903	3,081
Ohio	220,728	226,786	250,265	321,218
Oklahoma	101,087	164,266	167,043	191,130
Oregon	53,995	35,715	58,991	53,310
Pennsylvania	423,443	†365,107	351,940	476,001
Porto Rico	0	2,550	0	1,275
Rhode Island	18,409	19,352	10,166	19,874
South Carolina	44,723	42,537	56,022	47,821
South Dakota	6,413	5,094	18,848	10,170
Tennessee	66,379	86,485	86,871	102,871
Texas	270,231	362,004	364,107	371,525
Utah	10,655	13,356	15,613	15,527
Vermont	2,072	5,606	1,640	4,472
Virginia	61,645	62,199	77,572	92,723
Washington	72,393	104,608	77,936	124,266
West Virginia	39,983	47,871	45,121	64,296
Wisconsin	60,400	76,148	80,066	100,245
Wyoming	5,797	5,972	11,710	7,754
Unspecified	17,254	†19,886	†20,827	18,914
	5,602,541	5,894,569	†5,762,637	6,682,134
Foreign countries	71,459	73,431	†57,363	48,866
Total shipped from cement plants	5,674,000	5,968,000	5,820,000	†6,731,000

*Includes estimated distribution of shipments from three plants in January and February, 1927, and from four plants in January and February, 1926.

†Revised.

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY MONTHS, IN 1926 AND 1927, IN BARRELS

Month	Production 1926	Production 1927	Shipments 1926	Shipments 1927	Stocks at end of month 1926	Stocks at end of month 1927
January	7,887,000	8,258,000	5,674,000	5,968,000	20,582,000	22,914,000
February	7,731,000	*7,377,000	5,820,000	*6,731,000	22,385,000	*23,560,000
March	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,930,000
First quarter	26,008,000	27,087,000	21,033,000	23,782,000		
April	12,440,000		12,965,000		22,710,000	
May	16,510,000		17,973,000		21,255,000	
June	16,866,000		19,134,000		19,000,000	
Second quarter	45,816,000		50,072,000			
July	17,134,000		18,812,000		17,301,000	
August	16,995,000		18,583,000		15,718,000	
September	16,571,000		18,087,000		14,188,000	
Third quarter	50,700,000		55,482,000			
October	16,596,000		17,486,000		13,334,000	
November	14,193,000		11,276,000		16,243,000	
December	10,744,000		6,432,000		20,616,000	
Fourth quarter	41,533,000		35,194,000			
	164,057,000		161,781,000			

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT, BY DISTRICTS, IN MARCH, 1926 AND 1927, AND STOCKS IN FEBRUARY, 1927, IN BARRELS

Commercial district	Production 1926—March	Production March—1927	Shipments 1926—March	Shipments March—1927	Stocks at end of 1926—March	Stocks at end of March—1927	Stocks at end of Feb., 1927*
E'n Penn., N.J. & Md.	3,032,000	2,997,000	2,416,000	3,081,000	5,732,000	5,677,000	5,761,000
New York	374,000	597,000	335,000	481,000	1,629,000	1,568,000	1,453,000
Ohio, W'n Penn. and W. Va.	626,000	1,265,000	679,000	925,000	2,739,000	3,283,000	2,942,000
Michigan	223,000	551,000	390,000	596,000	1,780,000	1,975,000	2,019,000
Wis., Ill. Ind. & Ky.	1,208,000	1,290,000	942,000	1,187,000	3,966,000	3,341,000	3,239,000
Va., Tenn., Ala. & Ga.	1,241,000	1,201,000	1,189,000	1,220,000	1,111,000	1,178,000	1,197,000
E'n Mo., Iowa, Minn. and So. Dak.	744,000	714,000	724,000	729,000	3,087,000	3,226,000	3,241,000
W'n Mo., Neb., Kan. and Okla.	848,000	753,000	760,000	725,000	1,487,000	1,584,000	1,556,000
Texas	452,000	465,000	403,000	492,000	536,000	448,000	475,000
Colo., Mont. & Utah	142,000	118,000	191,000	138,000	308,000	462,000	482,000
California	1,259,000	1,196,000	1,264,000	1,196,000	501,000	704,000	704,000
Ore. and Wash.	241,000	305,000	246,000	313,000	360,000	484,000	491,000
	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	23,930,000	23,560,000

*Revised.

IMPORTS OF HYDRAULIC CEMENT BY COUNTRIES AND BY DISTRICTS, IN FEBRUARY, 1927

Imported from	District into which imported	Barrels	Value
Belgium	Florida	12,600	$21,188
	Georgia	15,000	23,209
	Massachusetts	26,350	32,433
	New Orleans	7,741	11,655
	New York	1	3
	Porto Rico	11,503	23,010
	San Francisco	6,015	8,168
	South Carolina	4,495	6,006
	Total	83,705	$125,672
Canada	Maine and New Hampshire	70	$268
	St. Lawrence	975	1,809
	Total	1,045	$2,077
Denmark and Faroe Islands	Porto Rico	38,148	$59,525
France	New York	500	$1,067
Norway	New York	1	$5
	Philadelphia	998	1,209
	Total	999	$1,214
United Kingdom	Massachusetts	1,500	$2,485
	Porto Rico	4,524	8,640
	Total	6,024	$11,125
	Grand total	130,421	$200,680

DOMESTIC HYDRAULIC CEMENT SHIPPED TO ALASKA, HAWAII AND PORTO RICO IN FEBRUARY, 1927*

	Barrels	Value
Alaska	416	$ 1,315
Hawaii	18,723	45,339
Porto Rico	6,575	16,395
	25,714	$63,049

*Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

EXPORTS AND IMPORTS*

EXPORTS OF HYDRAULIC CEMENT BY COUNTRIES, IN FEBRUARY, 1927

Exported to	Barrels	Value
Canada	1,933	$ 6,637
Central America	12,322	31,287
Cuba	8,474	21,582
Other West Indies and Bermuda	10,146	24,411
Mexico	8,547	25,821
South America	26,731	105,257
Other countries	3,251	18,990
	71,404	$233,985

EXPORTS AND IMPORTS OF HYDRAULIC CEMENT, BY MONTHS, IN 1926 AND 1927

Month	Exports 1926 Barrels	Exports 1926 Value	Exports 1927 Barrels	Exports 1927 Value	Imports 1926 Barrels	Imports 1926 Value	Imports 1927 Barrels	Imports 1927 Value
January	72,939	$216,431	75,346	$254,072	360,580	$576,717	193,175	$269,661
February	73,975	220,706	71,404	233,985	314,118	527,948	130,421	200,680
March	69,080	205,647			493,241	812,968		
April	96,296	284,772			257,302	398,114		
May	78,601	224,365			223,130	337,031		
June	80,684	248,814			335,570	495,744		
July	130,822	370,220			250,862	395,981		
August	64,946	216,489			350,638	560,532		
September	70,920	239,174			194,129	308,224		
October	69,389	225,874			263,403	386,335		
November	76,598	238,103			55,233	82,949		
December	89,976	305,238			151,850	246,293		
	974,226	$2,995,833			3,250,056	$5,128,836		

Latvia's Cement Industry

SIMILAR to Poland, Latvia had a considerable cement industry before the war which found a good market in Russia for its product due to the small Russian tariff. Production within the area of present-day Latvia during the last years preceding the war averaged about 450,000 bbl. of portland and 250,000 bags (220 lb.) of Roman cement per year. Only about one-half of this output was used in Latvia proper, the other half going to adjoining parts of Russia, chiefly the Lithuania of today. The cement industry was considerably broken up by the war, part of the machinery removed and its replacement handicapped by lack of capital. The present cement production of Latvia has not as yet reached its pre-war standards, so that a considerable quantity of cement is imported every year. The present annual production is estimated at 200,000 bbl. of portland cement and 30,000 to 40,000 bbl. of Roman cement. On the other hand, the demand for portland cement in Latvia has grown considerably, as reconstruction has now been begun. The Latvian cement is almost entirely marketed for domestic needs, only small quantities being exported to Lithuania. In 1925 the cement imports averaged 100,000 bbl. valued at 1,000,000 gold francs; in 1926 it rose to almost 1,800,000 gold francs. About 50% of the cement imports are from Sweden. The remainder comes chiefly from Esthonia and Germany, the latter supplying about 20% of the total imported. However, the tariff was raised considerably during the last year, as sufficient raw material is available in the country to increase the manufacture of cement. The conditions in Esthonia are different; the cement industry there has again reached an annual production of 750,000 bbl., of which about 80% is exported to foreign countries. While the price per barrel in Latvia averages 10 gold francs, in Esthonia this figure is but 830 Esthonian marks. It is doubtful whether the raising of the tariff will increase production in Latvia, as the plant equipment is quite antiquated. The tariff agreement between Latvia and Esthonia will limit the import opportunities of other countries, as Esthonia will be able to easily dispose of its surplus upon elimination of the tariff, particularly as Esthonian cement is said to be of good grade. The effect of this tariff agreement should become manifest only in 1928, as the tariff on Esthonian products is only gradually lowered in Latvia. *Tonindustrie-Zeitung* 1927, **18**, 284.

Propose South African Cement Mill

A NEW cement plant is expected to be erected in the near future at Port Elizabeth, Cape of Good Hope, South Africa, according to Vice Consul C. H. Hall, Jr., of that city. It is believed that this plant will be an important addition to the industries of Port Elizabeth and will probably give employment to about 600 men.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

(These are the most recent quotations available at this printing. Revisions, corrections and supplemental information will be welcomed by the editor.)

Stock	Date	Par	Price bid	Price asked	Dividend rate
Allentown Portland Cement Co. (common)[32]	Apr. 26	......	1½	3	
Allentown Portland Cement Co. (6% bonds, 1932)[32]	Apr. 26	......	87	92	
Alpha Portland Cement Co. (common)[2] new stock	Apr. 25	No par	41	41	37½c quar. Apr. 15
Alpha Portland Cement Co. (preferred)[2]	Apr. 25	100	115	......	1¾% quar. Mar. 1
American Lime and Stone Co. (7% bonds, 1942)[32]	Apr. 26	......	97	101	
Arundel Corporation (sand and gravel—new stock)	Apr. 26	No par	34⅝	34¾	50c April 1
Atlantic Gypsum Products Corp. (1st 6's carrying 10 sh. com.)[10]	Apr. 27	......	114	119	
Atlas Portland Cement Co. (common)[2]	Apr. 25	No par	42⅞	43⅞	50c qu. March 1
Atlas Portland Cement Co. (preferred)	......	100	......	......	2% quar. Oct. 1
Atlas Portland Cement Co. (preferred)[2]	Apr. 25	33⅓	43	44	2% quar. Apr. 1
Beaver Portland Cement Co. (1st Mort. 7's)[8]	July 29	100	100	100	
Bessemer Limestone and Cement Co. (Class A)[4]	Apr. 8	......	34	34¾	75c quar. May 1
Bessemer Limestone and Cement Co. (6½% bonds)[4]	Apr. 8	......	99	100	
Boston Sand and Gravel Co. (common)	Apr. 23	100	70	......	1% qu., 2% ex. Jan. 1
Boston Sand and Gravel Co. (preferred)	Apr. 23	......	......	85	1¾% quar. Jan. 1
Boston Sand and Gravel Co. (1st preferred)	Apr. 23	......	......	90	2% quar. Jan. 1
Canada Cement Co., Ltd. (common)	Apr. 25	100	144	145	1¾% April 16
Canada Cement Co., Ltd. (preferred)[11]	Apr. 25	100	120	......	1¾% quar. Feb. 16
Canada Cement Co., Ltd. (1st 6's, 1929)[11]	Apr. 25	......	101¼	102	3% semi-annual A&O
Canada Crushed Stone Corp., Ltd. (6½s, 1944)[11]	Apr. 25	100	94	98	
Charles Warner Co. (lime, crushed stone, sand and gravel)	Apr. 25	No par	24	......	50c Apr. 11
Charles Warner Co. (preferred)	Apr. 25	100	103	......	1¾% quar. Apr. 28
Charles Warner Co. (lime, crushed stone, sand and gravel) 7s, 1929[16]	Apr. 23	100	102	103½	
Cleveland Stone Co. (new stock)	Apr. 26	......	49	49	50c qu. June 15
Connecticut Quarries Co. (1st Mortgage 7% bonds)[17]	Apr. 23	100	104	......	
Consolidated Cement Corp. (1st Mort., 6½s, series A)[24]	Apr. 27	100	97	99	
Consolidated Cement Corp. (5 yr. 6½% gold notes)[24]	Apr. 27	100	96	100	
Consumers Rock and Gravel Co. (1st Mort. 7s)[18]	Apr. 22	100	99½	101½	
Coosa Portland Cement Co. (6% bonds, 1944)[32]	Apr. 26	......	70	......	
Coplay Portland Cement Co. (6% bonds, 1941)[32]	Apr. 26	......	88	......	
Dewey Portland Cement Co. (1st mort. 6's 1942)[30]	Apr. 27	100	99	......	
Dolese and Shepard Co. (crushed stone)[7]	Apr. 26	50	96	98	$1.50 Jan. 1, $1.50 ex. Jan. 1
Egyptian Portland Cement Co. 7% pfd.[21]	Apr. 22	......	85	95	1¾% quar. Oct. 1
Egyptian Portland Cement Co. (common)[21]	Apr. 22	......	5	7	40c quar. Oct. 1
Fredonia Portland Cement Co. (6½% bonds, 1940)[32]	Apr. 26	......	97	101	
Giant Portland Cement Co. (common)[2]	Apr. 25	50	55	65	
Giant Portland Cement Co. (preferred)[25]	Apr. 25	50	40	50	3½% and 19% ex. Dec. 15
Ideal Cement Co. (common)	Apr. 26	No par	83	85	$1 quar., $1 ex. Dec. 15
Ideal Cement Co. (preferred)[33]	Apr. 25	100	112½	113½	1¾% quar. Dec. 15
International Cement Corporation (common)	Apr. 26	No par	53½	53¾	$1 quar. Mar. 31
International Cement Corporation (preferred)[2]	Apr. 23	100	108	109	1¾% quar. Mar. 31
Kelley Island Lime and Transport Co.	Apr. 26	100	133	135	$2 quar. April 1
Lawrence Portland Cement Co.[2]	Apr. 25	100	100	103	2% quar.
Lehigh Portland Cement Co.[6]	Apr. 25	50	118	120	1½% quar.
Lyman Richey Sand and Gravel Co. (1st Mort. 6s, 1928 to 1931)[13]	Apr. 22	100	98	100	
Lyman Richey Sand and Gravel Co. (1st Mort. 6s, 1932 to 1935)[13]	Apr. 24	100	96	99	
Marblehead Lime Co. (1st Mort. 7's)[14]	Apr. 22	100	100	......	
Marblehead Lime Co. (5½% notes)[14]	Apr. 22	100	98	......	
Michigan Limestone and Chemical Co. (common)[6]	Apr. 25	......	26	28	
Michigan Limestone and Chemical Co. (preferred)[6]	Apr. 25	......	24	26	1¾% quar. July 15
Missouri Portland Cement Co.	Apr. 26	25	45½	45½	50c Feb. 1
Monolith Portland Cement Co. (common)[9]	Apr. 21	......	12⅜	12¾	8% ann. Jan. 2
Monolith Portland Cement Co. (units)[9]	Apr. 21	......	31⅛	32¼	
Monolith Portland Cement Co. (preferred)[9]	Apr. 21	......	9⅜	9¾	
National Gypsum Co. (common)[35]	Apr. 27	......	47½	49	
National Gypsum Co. (preferred)[35]	Apr. 27	......	81	83	
Nazareth Cement Co.[20]	Apr. 23	No par	29	31	75c quar. Apr. 1
Newaygo Portland Cement Co.[1]	Apr. 22	......	113	115	
Newaygo Portland Cement Co. (6½% bonds, 1938)[32]	Apr. 26	......	100	102	
New England Lime Co. (Series A, preferred)[14]	Apr. 22	100	95	96	
New England Lime Co. (Series B, preferred)[22]	Apr. 25	100	95	97	
New England Lime Co. (V.T.C.)[22]	Apr. 25	......	33	36	
New England Lime Co. (6s, 1935)[14]	Apr. 22	100	99	101	
New York Trap Rock Corp. (6% bonds, 1946)[32]	Apr. 26	......	97½	100	
North American Cement Corp. 6½s 1940 (with warrants)	Apr. 26	100	91	91½	
North American Cement Corp. (units of 1 sh. pfd. plus ½ sh. common)[32]	Apr. 26	......	62	67	2 mo. period at rate of 7%
North American Cement Corp. (common)[19]	Apr. 25	......	7¾	8⅞	
North American Cement Corp. (preferred)	Apr. 25	......	......	......	1.75 quar. May 2
North Shore Material Co. (1st Mort. 6's)[15]	Apr. 27	100	98½	100	
Pacific Portland Cement Co., Consolidated[5]	Apr. 21	100	63½	74	25c mo.
Pacific Portland Cement Co., Consolidated (secured serial gold notes)[5]	Apr. 21	100	98	......	3% semi-annual Oct. 15
Peerless Portland Cement Co.[1]	Apr. 22	10	5¼	5½	
Pennsylvania-Dixie Cement Corp. (1st Mort. 6's)[29]	Apr. 26	100	100¼	100¾	
Pennsylvania-Dixie Cement Corp. (preferred)[28]	Apr. 26	100	99	99	1¾% March 15
Pennsylvania-Dixie Cement Corp. (common)[28]	Apr. 26	......	36	37	80c April 1
Petoskey Portland Cement Co.[1]	Apr. 27	10	10	10½	1½% quar.
Pittsfield Lime and Stone Co.[31]	Apr. 26	......	......	100	
Pittsfield Lime and Stone Co.[31] (common)	Feb. 25	......	......	25	

(CONTINUED ON PAGE 74)

[1]Quotations by Watling, Lerchen & Hayes Co., Detroit, Mich. [2]Quotations by Bristol & Willett, New York. [3]Quotations by True, Webber & Co., Chicago. [4]Quotations by Butler, Beading & Co., Youngstown, Ohio. [5]Quotations by Freeman, Smith & Camp Co., San Francisco, Calif. [6]Quotations by Frederic H. Hatch & Co., New York. [7]Quotations by F. M. Zeiler & Co., Chicago, Ill. [8]Quotations by Ralph Schneeloch Co., Portland, Ore. [9]Quotations by A. E. White Co., San Francisco, Calif. [10]Quotations by Lee, Higginson & Co., Boston and Chicago. [11]Nesbitt, Thomson & Co., Montreal, Canada. [12]E. B. Merritt & Co., Inc., Bridgeport, Conn. [13]Peters Trust Co., Omaha, Neb. [14]Second Ward Securities Co., Milwaukee, Wis. [15]Central Trust Co. of Illinois, Chicago. [16]J. S. Wilson Jr. Co., Baltimore, Md. [17]Chas. W. Scranton & Co., New Haven, Conn. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hemphill, Noyes & Co., New York. [20]Quotations by Bond & Goodwin & Tucker, Inc., San Francisco. [21]Baker, Simonds & Co., Inc., New York. [22]William C. Simons, Inc., Springfield, Mass. [23]Blair & Co., New York and Chicago. [24]A. B. Leach and Co., Inc., Chicago. [25]A. C. Richards & Co., Philadelphia, Penn. [26]Hincks Bros. & Co., Bridgeport, Conn. [27]J. G. White and Co., New York. [28]Mitchell-Hutchins Co., Chicago, Ill. [29]National City Co., Chicago, Ill. [30]Chicago Trust Co., Chicago. [31]McIntyre & Co., New York, N. Y. [32]Hepburn & Co., New York. [33]Boettcher & Co., Denver, Colo. [34]Kidder, Peabody & Co., Boston, Mass. [35]Farnum, Winter and Co., Chicago.

Editorial Comment

The Future of Lime

May 17, 18, 19, 1927, are likely to prove momentous days in the history of the American lime industry; for the action taken on these days at the convention of the National Lime Association, at the Greenbrier hotel, White Sulphur Springs, W. Va., may result eventually in completely changing the present character of the lime industry. Apparently the National Lime Association has reached an impassé—a blind alley—where only heroic measures will prevent radical changes.

Going directly to the point, the real issue before the lime industry, as we see it, is whether the research and promotional work of the future will be done co-operatively by all or practically all of the producers, or whether such research and promotional work will be monopolized by two or three of the larger and more influential manufacturers.

There are today, probably, two or three, perhaps more, lime-manufacturing organizations large enough, strong enough and progressive enough to pick up this work where the National Lime Association is now in great danger of dropping it. Perhaps, if the conditions continue favorable, in the near future we shall see consolidations in the lime industry—perhaps a United States Lime Corp., like the Steel corporation, and the Gypsum corporation—which will leave little room for co-operative research and promotion.

There is, and always has been, a considerable number of lime manufacturers who are not sold on association research and promotion. These lime manufacturers —*all lime manufacturers*—are urged to attend the White Sulphur convention; and the interest, or lack of interest, they display will largely determine the future of the National Lime Association and, quite probably, the future character of the lime industry.

It seems to us that the few big organizations in the lime industry, which have until now carried by far the larger part of the financial burden of maintaining the National Lime Association, can better afford to do without its activities than the smaller producers; but, in our humble opinion neither large nor small producers are going to profit through the dropping of the association's present and future activities.

The National Lime Association has been through many vicissitudes, changes of policy and changes of management, but he is blind indeed who has followed the progress of the industry as closely as we have and not seen a tremendous amount of good come out of its efforts. It has given the lime industry prestige it never would otherwise have attained. No better proof of this can be had than the recent lime symposium at the Richmond meeting of the American Chemical Society, reported elsewhere in this issue. To divert and hold the attention of the chemical industry to lime, as was done in this instance, would have been a sheer impossibility five years ago. It was only possible of accomplishment because of the research work of the National Lime Association and the resulting prestige given the lime industry. If the National Lime Association never accomplished another thing it would have justified its existence for the past five years by this accomplishment.

So the National Lime Association has "sold" the chemical industry on the lime industry, but, unfortunately it has not sold the rank and file of lime manufacturers on their own industry. The lime industry has far more prestige outside the lime industry than it has inside. What is wrong with the National Lime Association?

In our opinion there is far less wrong with the National Lime Association than with the lime industry it represents. We believe the hand-to-mouth existence—the two-year leases of life—that the association has had to operate under truly has represented a hesitating, vacillating state of mind all too common in the lime industry. The rank and file of members have never been sold on the association as a research and promotional organization. They were willing to go along half-heartedly, but always with a chip on their shoulders, and ever ready to jump out of the fold at the least provocation.

Undoubtedly, as some pointedly say, the work and attitude of the association has been too "highbrow." It did not bear enough direct relation to their own sales. We believe the pioneer "highbrow" work of the association *had to be done* before *any* work could be done which would bear directly on any manufacturer's sales. A few of the larger and the more enterprising lime manufacturers realized this. They have built up their organizations and organized their sales effort to take advantage of this "highbrow" stuff. Others have regarded them evidently with mixed feeling of derision and envy.

Now, in our opinion, it is a mistake to think that a lime manufacturer must have an elaborate organization to profit from the research work of the National Lime Association. What the lime industry needs now is not necessarily the employment of chemists, it is the application of brains and common sense.

In every industry today, from pawn-brokerage to the manufacture of automobiles, the prime essential and the first requirement of success is an accurate knowledge of the product made or marketed. In every industry there are "practical" men who shut their eyes to all

(Continued on following page)

"scientific" knowledge. Although they seldom realize it in time to change, they are the "die-hards" who obstruct their own progress and prosperity, only to increase the opportunities of their competitors.

Let such men have as much contempt as they please for chemists, technical and scientific men generally, but let them not, for their own good and the future of their industry, despise scientific knowledge. For scientific knowledge is nothing more or less than organized common sense, and "practical" men, who pride themselves on their common sense certainly can have no quarrel with *organized common sense.*

Much stress has been laid (in the Lime Symposium elsewhere in this issue) on the necessity of modern, progressive lime manufacturers knowing their product thoroughly and of employing chemists to control its manufacture. With this we thoroughly agree; *BUT* our memory would be very short if we did not recall that the *first outstanding example* of a lime manufacturer to thus specialize, to thus scientifically control the selection of stone in the quarry, the burning and the selection of the lime was neither a big producer, nor one employing a chemist. It was a mere woman—Miss Mary E. Squire, secretary of the Allwood Lime Co., Manitowoc, Wis. Miss Squire, so far as we know, still makes the highest priced lime in the United States. She is doing, and has long been doing, all the things that some people are now urging only big organizations can do successfully.

No, it is not a chemist that many lime plants require; it is merely the application of a little chemical and scientific knowledge. It may be supplied by a chemist; it may be supplied by the proprietor; it may be supplied by the superintendent or the foreman. Someone in the organization, if it is to be successful in this day and generation, must have a brain capable of absorbing and applying a little scientific knowledge.

Now, then, the National Lime Association is a great educational institution. As such it deserves to be continued in no half-hearted way. Maybe a lot of its literature is too highbrow to be easily absorbed. If it is, this fault can be corrected. Perhaps it is more profitable, more convenient—easier in fact—to hire a chemist to absorb and use this technical knowledge, than to try and do it yourself. But if you are a lime producer and expect to stay in business very long and compete with large lime manufacturing organizations which do employ chemists—there are only about a dozen of these today—you have no alternative but to acquire and apply some technical knowledge of the product yourself; or to combine the office of chemist with that of superintendent, foreman, or salesmanager, and thus obtain the benefit of technical knowledge and its application.

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS (Continued)

Stock	Date	Par	Price Bid	Price Asked	Dividend Rate
Riverside Portland Cement Co.	Apr. 25	....	165	....	
Rockland and Rockport Lime Corp. (1st preferred)[34]	Apr. 23	100	103	....	3½% semi-annual Feb. 1
Rockland and Rockport Lime Corp. (2nd preferred)[34]	Apr. 23	100	60	....	3% semi-annual Feb. 1
Rockland and Rockport Lime Corp. (common)[34]	Apr. 23	No par	50	55	1½% quar. Nov. 2
Sandusky Cement Co. (common)[1]	Mar. 30	100	125	135	$2 qu. April 1
Santa Cruz Portland Cement Co. (bonds)[5]	Apr. 21	....	105¼	....	6% annual
Santa Cruz Portland Cement Co. (common)[5]	Apr. 21	....	87¼	92½	$1 quar., $1 ex. Jan. 1
Schumacher Wallboard Corp. (common)	Mar. 26	....	27¼	27¾	
Schumacher Wallboard Corp. (preferred)	Mar. 26	....	27¾	....	
Southwestern Portland Cement Co. (units)	Apr. 25	....	205	....	
Superior Portland Cement, Inc. (Class A)[20]	Apr. 21	....	43¼	44	
Superior Portland Cement, Inc. (Class B)[20]	Apr. 21	....	21½	22	
United Fuel and Supply Co. (sand and gravel) 1st Mort. 6s[27]	Apr. 8	100	98	100	
United Fuel and Supply Co. (sand and gravel) 6% gold notes[27]	Apr. 8	100	98	100	
United States Gypsum Co. (common)	Apr. 25	20	100	106¼	40c quar. March 31
United States Gypsum Co. (preferred)	Apr. 25	100	120	121	1¾% quar. March 31
Universal Gypsum Co. (common)[3]	Apr. 26	No par	10	11	
Universal Gypsum V.T.C.[3]	Apr. 27	No par	9½	10½	
Universal Gypsum Co. (preferred)[3]	Nov. 23	....	73	77	1½% Feb. 15
Universal Gypsum and Lime Co. (1st 6's, 1946)[3]	Apr. 27	100	....	96	
Union Rock Co. (7% serial gold bonds)[18]	Apr. 26	....	93	....	
Upper Hudson Stone Co. (1st 6's, 1951)[32]	Apr. 26	....	93	....	
Upper Hudson Stone Co. (1st 6's, 1937)[32]	Apr. 26	....	104	....	
Vulcanite Portland Cement Co. (7½% bonds, 1943)[32]	Apr. 27	100	98½	101	
Wisconsin Lime and Cement Co. (1st Mort. 6s, 1940)[15]	Apr. 25	10	5¼	6	
Wolverine Portland Cement Co.	Apr. 22	100	99	101	15c quar. May 16
Yosemite Portland Cement Co.	Apr. 25	....	7¾	....	

QUOTATIONS OF INACTIVE ROCK PRODUCTS SECURITIES

Stock	Date	Par	Price bid	Price asked	Dividend rate
Atlanta Shope Brick and Tile Co.[1]	Nov. 24	....	25c	....	
Benedict Stone Corp. (cast-stone) (50 sh. pfd. and 390 sh. com.)[1]	Dec. 29	....	$400 for the lot	....	
Blue Stone Quarry (60 shares)[2]	Mar. 16	....	$10¼ for the lot	....	
Coplay Cement Mfg. Co. (common) (4)	Dec. 16	....	12½	....	
Coplay Cement Mfg. Co. (preferred) (1)	Dec. 30	....	70	....	
Eastern Brick Corp. 7% cu. pfd.) (1)	Dec. 9	10	40c	....	
Eastern Brick Corp. (sand lime brick) (common) (1)	Dec. 9	10	40c	....	
Edison Portland Cement Co. (common)[4]	Sept. 11	50	20c	....	
Edison Portland Cement Co. (preferred)	Nov. 3	50	17½c(x)	....	
International Portland Cement Co., Ltd. (preferred)	Mar. 1	....	30	45	
Globe Phospate Co. ($10,000 1st mtg. bonds, $169.80 per $1000 paid on prin.)	Dec. 22	....	$50 for the lot	....	
Iroquois Sand & Gravel Co., Ltd. (2 sh. com. and 3 sh. pfd.) (1)	Mar. 17	....	$12 for the lot	....	
Limestone Products Corp. (150 sh. pfd., $50 par, and 150 sh. com., no par)	Dec. 22	....	$60 for the lot	....	
Missouri Portland Cement Co. (serial bonds)	Dec. 31	....	104¾	104¾	3¼% semi-annual
Olympic Portland Cement Co. (g)	Oct. 13	....	....	£1⅝	
Phosphate Mining Co. (1)	Nov. 24	....	1	....	
River Feldspar and Milling Co. (50 sh. com. and 50 sh. pfd.) (1)	June 23	....	$200 for the lot		
Rockport Granite Co. (1st 6's, 1934)[2]	Aug. 31	....	90	....	
Simbroco Stone Co.[2]	Apr. 20	....	12	12	
Southern Phosphate Corp.[6]	Sept. 15	....	1¼	....	
Tidewater Portland Cement Co. (3000 sh. com.)	Dec. 22	....	$6525 for the lot	....	
Vermont Milling Products Co. (slate granules) 22 sh. com. and 12 sh. pfd. (6)	Nov. 3	....	$1 for the lot	....	
Wabash Portland Cement Co.[1]	Aug. 3	50	60	100	
Winchester Brick Co. (preferred) (sand lime brick) (6)	Dec. 16	....	10c	....	

(g) Neidecker and Co., Ltd., London, England. (1) Price obtained at auction by Adrian H. Muller & Sons, New York. (2) Price obtained at auction by R. L. Day and Co., Boston. (3) Price obtained at auction by Weilepp-Bruton and Co., Baltimore. Md. (4) Price obtained at auction by Barnes and Lofland, Philadelphia, Pa. (5) Price obtained at auction for lot of 50 shares by R. L. Day and Co., Boston. Mass. (x) Price obtained at auction by Barnes and Lofland, Philadelphia, on November 3, 1925. (6) Price obtained at auction by Wise, Hobbs and Arnold, Boston, Mass.

International Cement First Quarter Report (1927)

INTERNATIONAL CEMENT CORP., New York, reports a net to surplus for the first quarter of 1927 of $906,292 as compared with $746,172 for the first quarter of 1926. These earnings, after allowing for preferred dividends, are equivalent to $1.31 per share for the 562,500 shares of common stock now outstanding.

INTERNATIONAL CEMENT CORP.—QUARTERLY REPORT

3 Mos. Ended Mar. 31	1927	1926
Gross sales, less discount, allowances, etc.	$4,856,468	$3,989,855
Cost of sales	2,527,419	2,003,417
Depreciation	323,462	252,415
Manufacturing profit	$2,005,588	$1,734,024
Selling, administration and general expense	904,267	806,529
Net profit	$1,101,321	$ 927,495
Miscellaneous income	Cr. 2,872	....
Interest, reserve for Federal tax, etc.	197,901	181,324
Net to surplus	$ 906,292	$ 746,172

Ship Canal Portland Sells Unissued Preferred Stock

IN a recent circular to shareholders the directors of the Ship Canal Portland Cement Manufacturers (England) say that as a result of important developments which will favorably affect the business of the company they have accepted an offer from an influential group for the unissued balance of preference shares amounting to 88,361 shares at par, i.e., 15s. per share, but they have made a proviso that one-third of these shares must be reserved for existing shareholders at this price for a time. The circular adds that the work on the new kiln is proceeding satisfactorily, and as a result of the introduction of new mechanical plant substantial economies have been effected, and the rate of production materially increased—*Quarry and Surveyors and Contractors Journal (England).*

Universal Gypsum and Lime 1926 Report

THE following gives the comparitive consolidated balance sheet as of December 31, 1926, and December 31, 1925, of the Universal Gypsum and Lime Co., Chicago:

Associated Portland Cement Manufacturers, Ltd. Report

THE 28th ordinary general meeting of the Associated Portland Cement Manufacturers, Ltd., England, was held recently, P. Malcolm Stewart, chairman, presiding. After briefly reviewing the company's widespread interest, the chairman said that since the meeting in 1925, when emphasis was placed on the necessity for improving the earning capacity of the fixed assets by modernizing the largest works, they had created at Bevans probably the finest cement works in Europe, with a present annual capacity of 375,000 tons, and with cement shipping facilities second to none in the world. In addition, the chamber kilns at the Crown works had been replaced by a rotary kiln plant, and both the Bevan and Crown factories were runing smoothly and producing cement of excellent quality at a low cost of manufacture. With the completion of the construction, now commenced, of the Swanscombe works, the company will have an annual productive capacity exceeding 1,250,000 tons from an efficient rotary kiln plant. Despite dislocation of business brought about by the coal stoppage, the company's sales organization was successful in selling in the home market a larger tonnage of cement than ever previously accomplished. It was evident that the extensive propaganda undertaken by the company during the last few years in showing the advantages of concrete for constructional purposes was bearing fruit. Regarding the prospects for the current year, the demand was well up to expectations for the spring period, and the factories were on full time.—*Chemistry and Industry.*

Markings on Foreign Cement Bags Must Show Origin in English

THE Cement Information Bureau, New York, recently took up with the Treasury Department at Washington instances in which it claimed that Section 304 of the Tariff Act was being violated by improper or entire lack of markings on bags in which foreign cement was being delivered. As a result, the acting commissioner of customs has made the following ruling in a letter to the collector of customs at New York. This ruling supersedes one by the appraiser of merchandise under which the marking referred to in Section 304 (a) of the Tariff Act had not been applied to imported cement. The acting commissioner of customs rules:

"It has been the practice under previous rulings of the department not to require marking to indicate the country of origin on containers of crude products. Cement, however, is a manufactured product and it is the understanding of the department that bags containing cement are usually, if not universally, stenciled or otherwise marked with the name or trade-mark of the manufacturer and perhaps other information. Such bags, therefore, should be required to be marked to indicate the country of origin of the cement under the second paragraph of Section 304 (a) of the Tariff Act."

American Refractories Institute to Hold Spring Meeting

THE program for the annual spring meeting of the American Refractories Institute, to be held on May 18 at the Hotel Traymre, Atlantic City, N. J., has been announced. The regular sessions will be followed by a golf tournament on Thursday, May 19. Everyone interested in the manufacture or use of refractory materials is invited to attend. A buffet luncheon will be served on the day of the technical meeting and in the evening there will be a dinner, to which special speakers have been invited. Reservations for this dinner should be made in advance through the secretary's office, 2202 Oliver building, Pittsburgh, Penn.

Penn-Dixie Cement Issues Permanent Bonds

THE permanent first mortgage sinking fund 6% gold bonds, series A, due 1941, of the Pennsylvania-Dixie Cement Corp., are now exchangeable for outstanding temporary bonds at the National City Bank of New York.

COMPARATIVE CONSOLIDATED BALANCE SHEET OF THE UNIVERSAL GYPSUM AND LIME CO.
(As of Dec. 31, 1925, and Dec. 31, 1926)

ASSETS

	1925	1926	Increase	Decrease
Cash	$ 252,448	$ 405,385	$ 152,937	....
Accounts receivable	418,037	599,908	181,871	....
Notes receivable	19,196	51,439	32,243	....
Inventories	443,978	657,637	213,659	....
Advances	13,641	19,045	5,405	....
Stocks and bonds	3,855	8,015	4,160	....
Total current assets	$1,151,155	$1,741,430	$ 590,275	....
Furniture and fixtures	$ 28,988	$ 49,220	$ 20,231	....
Land	82,174	345,224	263,050	....
Gypsite and lime deposits	509,777	808,077	298,300	....
Buildings	714,495	1,062,648	348,153	....
Machinery and equipment	1,781,758	2,737,622	955,864	....
Patents, trade marks, etc.	546,141	552,042	5,901	....
Leasehold rights	1,434,671	1,434,671	....	....
Deferred charges	141,762	538,835	397,073	....
Organization development expense	330,969	....	....	$ 330,969
Good will	1	72,875	72,874	....
Sinking fund to retire bonds	58,333	8,369	....	49,964
Bonds in treasury	14,500	....	....	14,500
TOTAL ASSETS	$6,794,724	$9,351,012	$2,951,721	$ 395,433

LIABILITIES

	1925	1926	Increase	Decrease
Accounts payable	$ 69,219	$ 161,176	$ 91,967	....
Notes payable	146,667	30,000	....	$ 116,667
Accrued expenses	57,927	113,741	55,815	....
Deferred credits	9,874	12,096	2,222	....
Dividends payable	....	12,000	12,000	....
Total current liabilities	$ 283,677	$ 329,014	$ 162,003	$ 116,667
First mortgage 7% bonds	$ 860,900	....	....	$ 860,900
First mortgage 6% bonds	....	$1,825,000	$1,825,000	....
Land mortgage	5,900	4,900	....	1,000
Reserves—				
For bad accounts	3,376	9,771	6,394	....
Bag liability	38,754	42,191	3,437	....
Bag loss and depreciation	....	18,327	18,327	....
Depletion	66,199	99,741	33,542	....
Depreciation	217,554	443,254	225,699	....
Federal taxes	20,000	1,591	....	18,409
Amortization of patents	6,501	10,075	3,574	....
Capital stock, preferred	2,295,300	4,000,000	1,704,700	....
Common	985,864	1,415,957	430,093	....
Subscribed	28,329	2,700	....	25,629
Insulex Corp. preferred	300,000	300,000	....	....
Surplus	$1,682,369	$ 848,492	....	$ 833,877
TOTAL LIABILITIES	$6,794,724	$9,351,012	$4,412,769	$1,856,481

Foreign Abstracts and Patent Review

Effect of Colloidal Silica on Lime and Lime Hydrate. Tests were made by the author (H. Luftschitz) in 1919 at the Dresden laboratory of the effect of colloidal silica on hydrated lime and quicklime. The results were compared with those of standard lime mortars. The colloidal silica used was in the form of a loose, yellowish powder containing about 60% silica and some moisture. Test specimens of the following compositions were made: Lime and sand (1:3 mortar), lime with a large proportion of colloidal silica plus sand (1:3 mortar) and lime with a little colloidal silica and added sand to make a 1:3 mortar. These were broken at the end of 7 and 28 days air and water storage to determine the tensile and compressive strengths. The best strengths were obtained with mortars of dolomitic lime and colloidal silica in the proportions of one to one-half (by weight) respectively.

The results proved that colloidal silica had a beneficial effect on the strength of lime mortar; that this effect was particularly pronounced in the case of burned and pulverized lime; that hydrated lime and portland cement showed opposite effects of silica. The conclusion was drawn that the quantity of free lime present in the cementing material was of importance and that calcined and pulverized products lying within the range of hydrated lime and portland cement were especially benefited.

The increase in strength of lime mortar due to colloidal silica admixtures is caused by the formation of lime-hydrosilicate. The more favorable effect on quicklime is explained by greater activity of this form in contact with water and by its fineness favoring maximum development of colloid chemical activity. *Tonindustrie-Zeitung* (1927), **17**, 259-62.

Rotary Electric Kiln for Calcining Limestone and Gypsum. Rotary type electric kiln (the "Calimite") comprising an inner tube member of steel upon which is wound a "Brightray" heat unit. A heat insulating covering surrounds the tube and winding to check radiation. The heating member, i.e., the tube and winding, is carried on a cradle and is rotated by runners moving over rollers on a fixed frame, the runners being kept at definite spaces by stay rods. The entire kiln is rotated by a worm drive.

At the ends of the kiln are insulated slip-rings of copper or copper alloy. Conductor bars adapted to received the ends of the resistance windings are used to connect the slip-rings at diametrically opposite positions. Carbon brushes in contact with the slip-rings receive the electrical energy from the power line, the current flow being from the brushes to the slip-rings, then to conductor bars and finally to the resistance winding heating the tube. Thermostats are arranged to control the furnace temperature.

The limestone or other material to be calcined is fed from bins to the kiln by a screw conveyor. After passing through the kiln the calcined product goes to a cooler at the discharge end and is discharged by gravity. The calcination time can be regulated by raising or lowering the feed end of the kiln by means of a screw, the speed of the material passing through the kiln being thus affected.

Advantages claimed for this type of kiln are: Perfect heat control, efficient treatment of fines, non-contamination of finished material by the products of combustion, pure Co_2 which can be recovered, elimination of fuel storage, utilization of 95% of heat as compared with 30% in usual lime-burning operations and its application to the distillation of oil shales.

The inventor estimates that with a 10-ft. kiln of this design calcining two tons of limestone per hour to produce about one ton of lime, the heating costs would be about 12s. 6d. ($3.10) per ton of lime produced. The electric kiln as developed can be used for roasting ores and other material where the temperature requirements do not exceed 1100 deg. C. E. Halloway, Melbourne, Australia, the inventor and patentee, is said to be engaged in building a 10x2-ft. internal diameter kiln of this type for the calcining of limestone.—*Chemical Engineering and Mining Review (Australia).*

Unsintered Hydraulic Cement. Clay or clay-like material is mixed with dry burnt lime or wet hydrated lime and the resulting mixture ground fine. The mixture is calcined at a temperature below the sintering point and the calcined material ground to the fineness of cement. The process admits the use of oil shale as a source of fuel and clayey material. *German Patent No.* 440,795.

Lime Mortar. Lime drawn from kilns while still hot is mixed and ground with moist slag or ashes under steam pressure and the material heated to drive off water. The steam treatment is said to increase the cementing power of the mixture. *W. Braun, German Patent No.* 428,431.

Artificial Stone. A 60% solution of magnesium sulphate is saturated with crystalline magnesium chloride and to this is added a mixture of one part of magnesium oxide and 4 parts calcium carbonate until a pasty mass is formed. The mass is poured into molds and allowed to set. *B. Hessellwitz, French Patent No.* 606,592.

Phosphoric Acid. Fine ground rock phosphate is mixed with powdered coal or other fuel to which silica or siliceous material is added and the whole injected into the combustion chamber by the blast of the primary or secondary air feeding the full burner. The phosphorous is volatized as such or oxide and air may be admitted to oxidize it to phosphoric acid, which is then electrically precipitated or absorbed chemically. *B. P. Hill, British Patent No.* 263,-576.

Effect of Gypsum on Soil. Information on the mining and use of gypsum in Victoria, B. C., is given, together with data from experiments on the effect of gypsum on soil. It was found to liberate potash from potash-containing minerals and to a lesser extent phosphoric acid, magnesia and silica. It also encouraged the growth of legumes, increased ammonification rate and flocculated the finer particles in soils. *Jour. Dept. Agr., Victoria* (1925), **24**, 65-74.

Effect of the Calcination Process on the Properties of Portland Cement (Continued). Two mixes each of 46 g. (corresponding to 28 g. of clinker) were calcined in electric furnaces and their heating, period of calcination and rate of cooling carefully observed. A standard portland cement mix and a mix high in iron oxide were used. A platinum foil and a silicon carbide resistance furnace were used. The former permitted temperatures up to 1500 deg. C.; the latter was used for temperatures up to 1400 deg. C. only. The temperature was measured by means of a platinum-rhodium thermocouple calibrated by a Siemens & Halske galvanometer.

The two clinkers were crushed in a mortar and then ground in a porcelain ball mill. The iron oxide clinker required much less time to reach the desired fineness of 10% retained on the 4900-mesh sieve; this seems to prove that it is more brittle than portland cement clinker, though harder than the latter.

The cements were tested at 24 hr., using Kuhl's apparatus for testing of small cement specimens. A 6-gm. sample of cement was mixed with 18 gm. of sand of definite grading with the addition of a constant quantity of 11% water. The mortar was mixed one minute. The sand was a standard sand passing 225 and retained on 900 mesh per sq. cm. sieves (about 40 and 75 mesh, American). The specimen dimensions were 30x10x10 mm. They were tested in accordance with standard procedure for tension and compression at ages of 3, 7 and 28 days. Each value was the average of four tests. Multiplying the bending strength obtained by this method by two gives the tensile strength; multiplying by 30, the compressive strength.

Supplementary tests were made of the

change of color of the clinker when cooled at sintering temperature. It was found that 1275 deg. C. was a critical temperature below which cooling resulted in black clinker, while above it the clinker was brown. This temperature may, therefore, be regarded as the beginning of a reaction between CaO and Fe_2O_3 resulting in the formation of calcium ferrites.

The effect of temperature of calcination was studied at temperatures of 1175 to 1500 deg. C. The jump in strength of mix I (portland) between 1250 and 1275 deg. C. is quite noticeable. At 1275 deg. C. the values are almost double those at 1250 deg. C., after which they remain almost constant. At 1275 deg. C. the clinker had a light yellow color. The normal greenish black color made its appearance only at 1400 deg. C.

The mix with high percentage of iron oxide yielded negligible strengths at 1275 deg. C. Only at temperatures above the latter could some rather low strengths be determined. Its hardness increases as that of portland cement. The color of this clinker is in general darker. At 1300 deg. C. it already appears dark grey; the clinker sintered at 1400 deg. C. assumes a dead black color.

The effect of period of sintering on strength was studied in another series. The mixes were sintered at 1400 deg. C. under identical conditions for periods of 20 min., 3 hr., 6 hr. and 12 hr. The results of 28-day tests are indicative of the variations. Portland cement clinkers cooled normally have a definite maximum at 6 hr.; this maximum is reached at 3 hr., when the clinkers are cooled suddenly. It must be emphasized that rapid cooling does not always improve the quality of cement. The iron oxide mix shows considerable improvement by sudden cooling after 20 min. sintering. Further sintering results in a reduction of strength. It is notable that in this series hardness increases parallel to strength, contrary to the first series of tests.

The effect of rate of cooling on strength was studied under 3-hr. heating, 20-min. calcination period, and varying periods of cooling to 500 deg. C. Upon sintering 20 min. the clinker was taken from the furnace and exposed to air. A 5-hr. cooling period was thus achieved, reproducing conditions of a shaft kiln. Portland cement shows best strengths for medium rate of cooling of 96 min., while the iron oxide mix yields highest values for sudden cooling. Hardness seems to increase through sudden cooling.

Accordingly, the strength of a cement is less a function of temperature of calcination and more that of calcination period. Further tests were made prolonging calcination to 3 and 6 hr. An actual rise in strength was thus recorded, which was in part superior to that observed in the first series at temperatures of 1300 deg. C. Decomposition of the clinker was observed in all cases.

Comparing this work with Kuhl's assumptions, we find the explanation: The carriers of the hydraulic properties of portland cement are isomorphic mixtures or solid solutions of $3CaO{\cdot}SiO_2$ with $3CaO{\cdot}Al_2O_3$ or $8CaO{\cdot}2SiO_2{\cdot}Al_2O_3$. The extent of the solution determines the hydraulic properties of the clinker.—*E. Ullrich, Zement* (1927), **9**, 165-70, **10**, 181-184.

Thermal Analysis of Plaster. The thermal analysis of plaster is carried out in a special apparatus designed by P. Jolibois and L. Chassevent—a truncated, conical brass vessel surrounded by a calorimeter jacket containing water, the temperature of which is electrically adjusted. The vessel holds the plaster, a thermometer being so placed that it dips into the mass. Control and classification of industrial plaster, according to their respective rate of hydration, can be obtained through this apparatus by measuring the beginning of the set; the rate of transformation into gypsum, the composition and resistance. There are given, in explanation of the process and apparatus, curves showing the temperature rise during setting, and the time for a number of different plasters. *Comptes Rendues* (1927), **184**, 202-204.

Artificial Stone. Eight to 12 parts of a glue solution (1 part glue in 40-70 of water) are mixed with one part lime water (1-4 parts lime in 3 parts water) and sufficient plaster of paris added to give a mass of suitable consistency. *F. R. A. Sundell, Swedish Patent No.* 60,904.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Superintendent of Documents, Government Printing Office, Washington, for each patent desired.

Hydraulic Cement from Unsintered Sand-Lime Mixtures. The mixed material, containing preferably from 30 to 60% of calcium carbonate or calcareous material and from 40 to 70% of silica such as sand, is first calcined at a low temperature sufficient to substantially decarbonate the calcium carbonate present, without producing any sintering of the material. The material is then ground to a fine power and is hydrated by being mixed with water, in amount sufficient to produce a stiff paste which can then be molded into blocks or other shapes, bricks, tiles and the like, the said materials thereafter being subjected to an induration treatment by the action of steam or carbon dioxide or both, preferably under a pressure of, say, 25 atmospheres until the hardened blocks are completely indurated and cured.

The raw material after calcination or before calcination, or both, can be subjected to a washing operation if desired to remove soluble salts, and the calcined material may contain, for instance, 60% of lime, 25% of silica, 5% of alumina (e.g. in the form of clay or partially decomposed feldspathic rock), 3% of magnesia and the like.

The blocks, prepared as above, can if desired first be crushed or broken to small size (preferably ⅛-in. to 1¼-in. ring), using any suitable machinery for the purpose, and the bodies can then be subjected to burning, after which they can be ground to a fineness corresponding to portland cement. In some cases the blocks do not have to be crushed before burning.

The burning operation may be conducted in a tunnel kiln at a temperature of about 400 to 600 deg. C., but temperatures substantially above 600 deg. C. should be avoided so far as possible, in order to leave in the calcined product about 9 to 11% of chemically combined water. The operation through a tunnel kiln for burning may require several hours.

The burned product upon analysis has been found to consist of a combination of calcium hydroxide, calcium monosilicate and calcium bisilicate, and probably also some tricalcium silicate.

For using the cement, the ordinary procedures and the ordinary formulas for portland cement mixtures can be generally followed.

It will be understood that the process of making cement will be the same, whether the induration treatment has been conducted with gases containing carbon dioxide, or with steam containing no appreciable amount of carbon dioxide, or with mixtures of such two kinds of gases. This fact is believed to be quite unexpected in view of the fact that the temperature stated is below that at which the decarbonation of calcium carbonate is complete or even substantially complete. *Ludwig Kern, U. S. Patent No.* 1,623,876.

Magnesite Refractory. Magnesite bricks or molded refractories, comprising mixing a pulverized magnesitic body material with linseed oil, molding, curing the molded article and burning. *A. Marks, U. S. No.* 1,616,055.

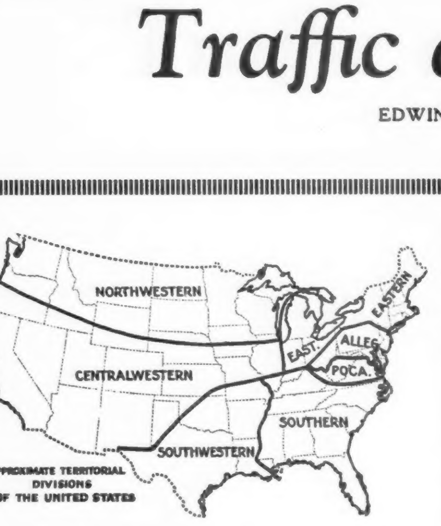
Building Block. A block comprising a mixture of about two parts of crushed burnt slate, one part wood sawdust, and one part of portland cement and water, and a small amount of calcium stearate. *Ellis Roberts, U. S. No.* 1,623,442.

Porous Cement Product. Process of producing a porous cementitious article consisting in mixing cement in granulated form, hydrated lime, aluminum and warm water, molding the article during the gas liberation, securing the article within the mold and rotating the mold during the setting operation to compel formation of substantial uniform voids in the mass to the gas passage therethrough. *A. T. Schenck, U. S. No.* 1,622,396.

Cement Block Composition. Burnt fuel residue is treated with mineral acid to remove sulphates, after which the residue is washed to remove soluble matter. The residue is then mixed with cement, wood fibre, lime and plaster of paris to make a suitable cement block mix. *M. E. Von Mach, Jr., U. S. No.* 1,623,985.

Traffic and Transportation

EDWIN BROOKER, Consulting Transportation and Traffic Expert
Munsey Building, Washington, D. C.



Car Loadings of Sand and Gravel, Stone and Limestone Flux

THE following are the weekly car loadings of sand and gravel, crushed stone and limestone flux (by railroad districts), as reported by the Car Service Division, American Railway Association, Washington, D. C.:

CAR LOADINGS OF SAND, GRAVEL, STONE AND LIMESTONE FLUX

District	Limestone Flux Week Ended March 26	April 2	Sand, Stone and Gravel Week Ended March 26	April 2
Eastern	2,753	3,059	3,864	5,102
Allegheny	3,347	3,390	4,969	6,409
Pocahontas	358	366	532	646
Southern	539	525	10,374	10,339
Northwestern	1,445	1,356	4,650	4,637
Central western	398	423	8,168	7,295
Southwestern	379	317	4,504	4,728
Total	9,219	9,436	37,061	39,156

The following are the comparative total loadings of sand and gravel, crushed stone and limestone flux (by railroad districts) for like periods in 1926 and 1927:

COMPARATIVE TOTAL LOADINGS, BY DISTRICTS, 1926 AND 1927

District	Limestone flux 1926 Period to date. April 3	1927 April 2	Sand, gravel and stone 1926 Period to date. April 3	1927 April 2
Eastern	34,026	41,843	28,271	30,537
Allegheny	43,810	44,003	31,616	42,985
Pocahontas	3,622	2,735	5,365	5,282
Southern	8,496	6,691	115,897	134,279
Northwestern	12,277	13,170	26,167	36,001
Central western	6,184	5,595	80,786	76,180
Southwestern	2,331	3,880	45,953	55,869
Total	110,746	117,917	334,055	381,133

COMPARATIVE TOTAL LOADINGS 1926 AND 1927

	1926	1927
Limestone flux	*110,746*	*117,917*
Sand, stone and gravel	*334,055*	*381,133*

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week beginning April 25:

CENTRAL FREIGHT ASSOCIATION DOCKET

15424. To establish rate of 63c per net ton on **crushed stone** and articles taking same rates, in bulk, carload, Bluffton, Ind., to Decatur, Peterson and Craigsville, Ind. Present rate—69c per net ton.

15427. To establish on **sand**, blast, core, engine, filter, fire, or furnace, glass, grinding or polishing, loam, moulding or silica, carload, rate of 164c per net ton, Rush Run, Ohio, to West Newton, Pa. Route: P. R. R. Pittsburgh & B. & O. R. R. Present rate 16½c.

15434. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, moulding or silica) and gravel, carload, Attica, Ind., to various points in Illinois, following rates (per net ton).

To—	Present	Proposed
Crescent City	280	101
Eastburn	270	101
Effner	270	101
Gilman	280	101
La Hogue	300	101
Leonard	280	101
Piper City	300	101
Sheldon	270	101
Watseka	270	101
Webster	270	101

15438. To establish rate of 100c per net ton on **crushed stone**, carload, Lewisburg, O., to Bridgetown, O. Present rate 113c per net ton.

15440. To establish on **gravel and sand**, except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, moulding or silica, in open top cars, carload, rate of 75c per net ton, Columbus, Ind., to No. Madison, Ind. Present rate 85c per net ton.

15441. To publish rate of 101c per net ton on **crushed stone**, in bulk in open top cars only, Chicago and points taking same rates to Hill Top, Mich. Present rate 115c per net ton.

15462. To establish on **gravel and sand**, except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing loam, moulding or silica, rate of 50c per net ton, Connersville, Ind., to Brookville, Ind. Present rate, 6th Class.

15466. To establish on **gravel and sand**, except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing loam, moulding or silica, carload, rate of 70c per net ton, Connersville, Ind., to Cincinnati, O. Present rate, 6th Class.

ILLINOIS FREIGHT ASSOCIATION DOCKET

4049. **Sand** (except blast, core, engine, filter, fire or furnace, foundry, etc.), carload, minimum weight 90% of marked capacity of car, except when car is loaded to full cubical or visible capacity, actual weight will apply, from Attica, Ind. (rates per net ton).

To T. P. & W. Ry. Stations—	Present	Proposed
Effner, Ill.	$2.70	$1.01
Sheldon, Ill.	2.70	1.01
Webster, Ill.	2.70	1.01
Eastburn, Ill.	2.70	1.01
Watseka, Ill.	2.70	1.01
Crescent City, Ill.	2.80	1.01
Leonard, Ill.	2.80	1.01
Gilman, Ill.	2.80	1.01
La Hague, Ill.	3.00	1.01
Piper City, Ill.	3.00	1.01

2585H. **Sand**, from Oregon, Sheridan, Wedron, Millington, Ottawa and Utica, Ill., to Hannibal and St. Louis, Mo. Rates in cents per ton. Present, 177; proposed, 164.

2655. **Sand or gravel** (not molding or silica), minimum weight 90% of marked capacity of car, from Spring Valley, Ill., to stations on the C. B. & Q. R. R. in Illinois.

To (Representative points)	Rates per net ton Pres.	Prop.
Grand Ridge, Ill.	.88	.76
Streator, Ill.	.75	.70
Ladd, Ill.	.63	.60
Rochelle, Ill.	.90	.88
Monica, Ill.	1.01	.95
Prairie City, Ill.	1.13	1.01

SOUTHERN FREIGHT ASSOCIATION DOCKET

33207. **Marble**, crushed, from Gantt's Quarry, Ala., to Roanoke, Va. Present rate, 430c per net ton. Proposed rate on marble, crushed, carload, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity actual weight will govern, from Gantt's Quarry, Ala., to Roanoke, Va., 350c per net ton, made in line with rates in effect from this point to Lynchburg, Va., and other Virginia cities.

33274. **Sand and gravel** from Gadsden, Ala., to Cedartown, Ga. It is proposed to establish reduced rate of 102½c per 100 lbs. on sand and gravel, carload, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity, actual weight will govern, from Gadsden, Ala., to Cedartown, Ga., same as rate in effect from Chattanooga, Tenn., to Cedartown, Ga.

33284. **Granite or stone**, crushed, etc., from Greystone, N. C., to South Hill, Va. Present rate, 117c per net ton. (LaCrosse, Va., combination). Proposed rate on—Granite or stone, crushed or rubble, carload, minimum weight 90% of marked capacity of car, except when cars are loaded to their visible capacity, actual weight will govern —from Greystone, N. C., to South Hill, Va., 99c per net ton, made on basis of the proposed Georgia joint line scale, for distance via S. A. L. Ry., LaCrosse, Va., So. Ry.

SOUTHWESTERN FREIGHT BUREAU DOCKET

11880. **Limestone**, from Texas points to Oklahoma points. To establish the following distance scale of rates on ground limestone, carloads, minimum weight marked capacity of car, except when cars are loaded to actual visible loading capacity, actual weight will govern, but not less than 50,000 lb., from Harrys' Eagle Ford and Ft. Worth, Tex., to Oklahoma points.

Miles	Single Line	Two Lines	Three Lines
100 and over 90	5½	7	8
130 and over 100	6½	7	8½
150 and over 130	7	8	9
175 and over 150	7	8½	10
225 and over 175	8	9	10½
250 and over 225	8½	10	11
275 and over 250	9	10½	11½
300 and over 275	10	11½	12½
350 and over 300	10½	12	13
400 and over 350	11½	13	14
450 and over 400	12½	14	15½
500 and over 450	13½	15	16

The proposed scale, it is stated, is the Oklahoma-Texas scale as published in Item 4119D of S. W. L. Tariff 26X, holding the Oklahoma intrastate scale as published in S. W. L. Tariff 55-I as minimum.

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

12118. **Stone**, crushed (trap rock), carload, minimum weight 90% of marked capacity of car, but in no case less than 27 net tons of 2,000 lb., from Westfield, Mass., to Philmont, Martindale, Craryville, Hillsdale, Copake Falls, Boston Corners, Mount Riga, and Millerton, N. Y., 110c per ton of 2,000 lb., via B. & A. R. R.-Chatham, N. Y.-N. Y. C. R. R. Reason—To equalize rate via competing carrier.

11997. **Sand-lime brick**, carloads, minimum weight 60,000 lb., from Winchester, Mass., to Worcester, Mass., 7. Reason—To meet carload competition.

12056. **Sand**, building, common or run of bank, and stone, broken or crushed, carloads, minimum weight 90% of marked capacity of car, except when in excess of maximum weight limit, when maximum weight limits will be the minimum carload weight, sand from Avon, New Haven, Conn., and crushed stone from Rocky Hill and Branford (Pine Orchard Quarry), Conn., to Higganum, Conn., rates: Sand, 70; crushed stone 70c per ton of 2000 lb. Reason—To permit of a rail movement of the traffic.

11993. **Sand**, sea, carloads, minimum weight 90% marked capacity of car, from Provincetown, Mass., to Rochester, Syracuse and Utica, N. Y., 19c, route to Syracuse and Utica via N. Y. N. H. & H., D. L. & W., N. Y. O. & W. or N. Y. C. R. R., and to Rochester, N. Y., via N. Y. N. H. & H., L. V., P. R. R. or Erie R. R. Reason—to provide same rate as is now in effect to Buffalo, N. Y.

11994. **Lime**, carloads, minimum weight 40,000 lb., from Cheshire, Farnams, North Adams, Renfrew, Richmond and Zylonite, Mass., to Fonda, Johnstown & Gloversville R. R. stations—Johnstown N. Y., $3.40; Gloversville, N. Y., $3.50; Broadalbin, N. Y., $3.60; Mayfield, N. Y., $3.60; Cranberry Creek, N. Y., $3.70; Northville, N. Y., $3.80 per ton of 2000 lb., via B. & A. R. R.-Selkirk Junction, N. Y., or West Albany Transfer, N. Y., N. Y. C. R. R.-Fonda, N. Y., and F. J. & G. R. R. to destination. Reason—To establish same rates from B. & A. R. R. lime shipping stations as in effect from Dover Plains, N. Y.

12061. **Lime**, carloads, minimum weight 50,000 lb., from Lee, Mass., to West Albany, N. Y., 12½c. Reason—Present rate too high.

12092. **Lime**, carloads, minimum weight 50,000 lb., from Bethel, Brookfield, Danbury, Redding, Canaan, East Canaan, Conn., Great Barrington, Sheffield, Lee, Mass., Long Hill, New Milford, Stevenson, Conn., West Stockbridge and Pittsfield, Mass., to Glenwood, Mass., 18½c. Reason—Present rate too high.

17817. Hearing to interpret "Chicago, Ill.-Gary district" and the "Chicago-Gary switching district." No dispute that commission intended to place sand and gravel rates to Chicago and Gary on a parity. Carriers claimed compliance with order and made tariff effective April 30 which makes rates the same to Chicago as to Gary from the territory involved. This increased rates from Indiana points to Gary and lowered Gary rates from origin points in Illinois and Wisconsin. Ten days assigned for shippers to set forth complaint and carriers to reply.

I. and S. 2851. Joint hearing with Docket 8856 involving suspension proposed to increase rate of sand and gravel from Pleasant Lake to Chicago from 80 to 96 cents. Carrier introduced testimony showing that territory outside Chicago had been zoned into three 50-mile blocks with a 5-cent differential between zones, the rate from outer zone to Chicago being 75 cents. Rate comparisons were made to show that proposed rate was not as high as rates applicable in territory. Claimed that overproduction in pits adjacent to complainant and that complainant could not be considered as a competitor for Chicago market; further, there were numerous large markets nearer to Pleasant Lake than Chicago. Complainant testified that 96-cent rate prohibited doing business in Chicago, citing decrease in his shipments since rate superseded the 80-cent rate. He also introduced evidence from customers concerning the commercial justification for the continuation of the 80-cent rate.

17188. A finding of undue prejudice, with a denial of reparation because no damage was shown, has been made as to rates on sand and gravel from Janesville, Afton and Beloit, Wis., to complainant's plant in the Mayfair district in Chicago, between July 2, 1923, and November 2, 1923, inclusive, and to complainant's plant in the Weber district in Chicago, between June 19, 1923, and May 24, 1925. The rates were not unreasonable or unjustly discriminatory.

18874. Complainant alleges that rates charged on sand and gravel, in carloads, from Koss Spur, Iowa, to points in Illinois are unreasonable, unduly preferential of competitors in Illinois and unduly prejudicial to complainant in violation of sections 1, 3 and 6 of the interstate commerce act. The commission is asked to prescribe reasonable rates and to award reparation.

I. and S. 2880. By order entered March 30, the I. C. C. has suspended from March 31 to October 31, 1927, the operation of certain schedules as published in the following tariffs: J. E. Johanson, agent: Supplements Nos. 153 and 154 to I. C. C. No. 1590; Supplement No. 11 to I. C. C. C. No. 1836.

The suspended schedules propose to restrict the rates on cement, in carloads, from Ada, Okla., and other origins to points in Arkansas, Louisiana and Mississippi, so as to not apply over certain routes through Texas, and to revise rates on cement, in carloads, between Oklahoma and Texas points, also between points in Texas, resulting in both increases and reductions.

Hearing on Slag and Gravel Rates to Chicago and Gary Districts

HEARING in docket 17817, Chicago Gravel Co. and others against the A. T. & S. F. and others (further hearing solely with respect to the allegation of undue prejudice and undue preference against complainants in favor of producers of slag at Joliet, Ill.) was held in Chicago recently before Examiner Fuller.

In the commission's order in 17817 it raised the rate on slag from Joliet to Chicago and Gary from 38 cents a ton to 65 cents, placing it on a parity with sand and gravel—which was increased from 50 to 65 cents—on the theory that the 38-cent rate was prejudicial to shippers of sand and gravel. The hearing was reopened on the petition of the Illinois Slag and Ballast Co., an intervener.

H. P. Holland, superintendent of the blast furnaces of the Wisconsin Steel Works, explained the operation of a blast furnace and the production of slag. He said slag was a waste product created in the production of steel and that the necessity for disposing of it was a serious problem to the steel mills. He said his company paid a contractor $15 a car for taking slag away.

William C. McKee, general superintendent, Federal furnace plant of the Byproducts Coke Corp., Ervin Rule, superintendent, South Chicago Works, Youngstown Sheet and Tool Co. and William J. Rossman, superintendent of transportation, Inland Steel Co., gave similar testimony. Mr. McKee said disposal of the slag was an essential part of the production of steel. He said his plant had operated a crushing mill for its disposal previous to 1917, but that, in that year, the plant had burned and since then it had been required to pay to get rid of it. He said his plant would not be able to operate more than 18 months unless it was able to dispose of its slag, and that it was building a new crushing mill, involving an investment of approximately $250,000 in hopes that it would be able to "break even" on its disposition.

James A. Parsons, superintendent, Illinois Slag and Ballast Co., described the processes involved in the removal of slag from the pile at the steel mill, its removal to the plant of his company and the crushing of it. He said slag was much more destructive to all the equipment involved than was sand or gravel.

Emil G. Seip, president, Calumet National Bank, and, previous to 1925, president, Illinois Slag and Ballast Co., gave testimony with reference to the market for slag and the competition. He said it was used for concrete work, ballast, road work and filling, and was in competition with gravel and crushed stone, but that its sale for such work required the education of customers, due to the natural prejudice against it as a waste product. He said few state or city boards included it in their specifications for such work as required the use of a coarse aggregate. He said the intervening company was the only plant of the sort in the Chicago territory.

L. E. McDermut, president, Illinois Slag and Ballast Co., gave further testimony concerning production and sale. He said that, in bidding for jobs, his company customarily found it necessary to make a price concession of from 20 to 30 cents a ton, and that it had found it necessary to go into the contracting business to dispose of its product.

G. W. Renwick, sales manager, Chicago Gravel Co., said slag competed in all respects for concrete and building work, and gave the details of his experience in that connection. He said gravel was under a similar handicap with relation to crushed stone as that claimed regarding slag from the point of view of educating prospective customers. He said that, while slag at the steel mill might be regarded as a refuse or waste product, the commercial product, crushed and screened, as prepared by the plant of the intervener, could not be so regarded.

Walter E. McCornack, representing the Chicago Gravel Co., said he was not opposed to the slag producer obtaining any adjustment of rates possible, but that he felt that slag and gravel should be on the same basis. He said he was not contending that the 65-cent rate to Chicago was a proper rate.—*Traffic World.*

Texas Revises Rates on Rock Products

THE Texas Railroad Commission has recently taken action on the long pending rate cases on crushed stone and sand and gravel. A complete revision is made of the existing rates on those commodities, with special changes in medium distances to meet conditions. These changes were made to eliminate the two-scale rates applying separately on commercial shipments and those for municipal purposes. One rate now applies. Irregular and improper gradation in scales have been corrected and the rates all placed on a per ton basis. A shorter initial group has been adopted, the present minimum being for 20 miles or less. A new tariff providing for a differential of 20 cents per ton between rough stone and crushed stone, sand and gravel has been drawn up.

The commission continues the same rate basis on asphalt and asphalt-coated articles, refusing the petition of the crushed stone, sand, gravel and brick interests to raise the rates on the asphalt materials. They will continue to take the crushed stone rates. Reductions are made in the rates in several instances, said not to be large by the commission, and the opinion holds that the exceptions thereto taken by the carriers are not well grounded and that they are justified by the facts.

The commission has canceled the rates to Fort Worth from Hart Spur and forced the movement under the mileage rates, holding they are not intra-city shipments. This places Bonner Spur and Hart on a parity and Tarrant and Grand Prairie on a basis 7 cents higher. A rate of 50 cents per ton is established on hand from Enos and Husan to Houston as a fair charge to compete with San Jacinto River sand. The present rate of 80 cents from Romayor to Port Arthur has been ordered maintained; from Liberty to Kansas City Southern points south of Beaumont the scale rates would be 84 and 90 cents, and the commission orders Liberty equalized with an 80-cent rate, the same as Romayor.

Mid-West Quarry Men Meet at St. Louis

Annual Frolic of the St. Louis Quarrymen's Association a Most Enjoyable Event

THE second annual dinner and frolic of the St. Louis Quarrymen's Association on Saturday, April 23, was made the occasion of an interesting meeting of the Mid-West Division of the National Crushed Stone Association, as well as a most enjoyable dinner and entertainment. Col. E. J. McMahon, executive secretary of the St. Louis Quarrymen's Association, was master of ceremonies and a most excellent host.

A meeting of the Mid-West Division of the National Crushed Stone Association was held in the afternoon preceding the St. Louis members' dinner. In the absence of Col. O. P. Chamberlain, of Chicago, president of the division, W. R. Sanborn, of Kankakee, regional vice-president of the National Crushed Stone Association, presided. Mr. Sanborn brought up the matter of the new mining commission of the state of Illinois, which has the power under the act creating it, to require owners of all mines, quarries and gravel pits in the state to supply the commission with statistics of production and prices. After some discussion, on a motion made by E. J. Krause, of St. Louis, it was voted to notify the chairman of the mining commission that the Illinois quarry operators are opposed to supplying such statistics.

Colonel McMahon, executive secretary of the St. Louis Quarrymen's Association, described briefly a post-card system of publicity for crushed stone he has developed, which has proved both economical and effective. That this publicity really has brought returns is evidenced by the fact that while the value of building permits in St. Louis for the first quarter of 1927 are about 50% less than for the same quarter in 1926, the consumption of crushed stone increased about 15% in 1927 over the 1926 quarter.

National Officers Present

President Otho M. Graves, of the National Crushed Stone Association, of Easton, Penn., spoke on the prospects of developing the engineering bureau of the association, and of the research work ahead of the engineering bureau in order to utilize its opportunities to the best advantage. A. T. Goldbeck, chief of the engineering bureau of the association, told of recent developments in studies of concrete aggregates, which are likely to have an important bearing on the future of the quarry industry. J. R. Boyd, secretary of the National Crushed Stone Association, was present and made a short address on the general work of his office.

W. F. Wise, of San Antonio, Texas, regional vice-president of the National Crushed Stone Association, was present. R. Newton McDowell, Kansas City, Mo., and Fred C. Murphy, Chicago, directors of the National Association, were also in attendance.

W. R. Sanborn, Regional Vice-President, National Crushed Stone Association

Standards Yearbook for 1927

THE first issue of the Standards Yearbook, a feature which will be brought out annually hereafter, has been recently published by the Bureau of Standards, Department of Commerce, Washington, D. C. It contains outlines of the activities and accomplishments of the bureau, other government and state agencies, American technical societies and associations which have been concerned with advancement of standardization.

The yearbook should be very useful to rock products manufacturers, engineers and industrial experts for many inquiries dealing with standardization practice are answered therein. As a companion volume to the Commerce Yearbook which deals strictly with industry and commerce, the Standards Yearbook deals strictly with standards and standardization.

Bakersfield Rock and Gravel to Enlarge Plant

EXPENDITURES of $25,000 in erecting an addition to its plant northeast of Bakersfield, Calif., on the Kern river has been announced by the Bakersfield Rock and Gravel Co., according to the Fresno (Calif.) *Republican*. It is also planned to construct another $25,000 addition within 60 days. When the expansion is completed the Bakersfield Rock and Gravel Co. will represent an investment of $200,000.

The company has installed an additional washing system, an extensive conveyor system and a gas power shovel. In addition, modern showers and washrooms for the employes have been built. The new construction work to be done at an additional $25,000 expenditure will include the installation of a sand conveyor system and storage bunkers.

The present plant of the Bakersfield company was completed early in 1926 and was described in Rock Products, July 24, 1926, issue.

Regional Safety Conference To Be Held May 17

THE northwestern Pennsylvania regional safety conference will be held in Erie, Penn., May 17. Organizations taking part are the Erie Safety Council, National Safety Council, Manufacturers Association, Chamber of Commerce and other prominent groups. Mayor Williams of Erie will greet the delegates.

Although Walter Duff, New Castle Lime and Stone Co., will make the only speech which directly treats of safety work in the quarry industry, delegates from that industry will find other talks on the program of more than casual interest.

Increase Production of Sand-Lime Brick in 1926

THE Department of Commerce announces that according to data collected at the annual census of sand-lime brick production taken in 1927, 42 establishments, which were in operation on an average of 217 days in the year, reported the prodution in 1926 of 330,586,000 brick, valued at $3,981,492. This represents increases of 4.8% in quantity and 5.3% in value as compared with 315,595,000 valued at $3,780,639 reported for 1925, and of 16.6% in quantity and 19.4% in value as compared with 283,417,000 valued at $3,334,-503 reported for 1924.

North American Cement Takes Out Group Insurance

THE North American Cement Corp. of Albany, N. Y., acting through John J. Porter, vice-president and general manager, has taken out group life insurance for its employes, according to the *Eastern Underwriters* (New York).

To Develop Montana Gypsum Deposit

PRELIMINARY work on the gypsum deposit in northern Wyoming to be developed by the Midland Gypsum Co. will begin shortly, according to a reported announcement by Fred Whiteside, president of the company.

An effort is being made to interest Montana farmers in the company. The deposit is 100 miles south of Billings between Lovell and Greybull on the Burlington railway line to Casper. The company is incorporated with a capital of $100,000 and besides Mr. Whiteside other men promoting the company are G. C. Thompson and Fred Soular, both of Billings.

The deposit is well situated for development, Mr. Whiteside said, as it is near a natural gas field from which fuel can be obtained and is above the railroad so that gravity may be used in handling the material. The deposit is 50 ft. in thickness, he said.

The company plans to produce agricultural gypsum, for which it is claimed there is a good market in the vicinity. The gypsum products field may be entered at a later time, the report states.—*Billings* (Mont.) *Gazette.*

"Gypsum King," a Specially Designed Gypsum Carrier's Maiden Voyage

THE *Gypsum King,* the first vessel built especially for the gypsum-carrying trade, is now making her maiden voyage. This boat was built in English yards for the United States Gypsum Transportation Co. Two similar vessels, the *Gypsum Queen* and the *Gypsum Prince,* now are near completion in England. All three vessels are built after the Isherwood system of naval construction —a hull within a hull.

The *Gypsum King* arrived at Windsor, Nova Scotia, on April 10 from England and left Windsor with a cargo of gypsum rock for the New Brighton, Staten Island, manufactory of the United States Gypsum Co. on April 12. All three boats will operate between New Brighton and Windsor.

Because of the tidal conditions in the Bay of Funday, off which Windsor is located, these three boats are so built that they can rest on dry land while being loaded. Brought to their loading berths on one tide, the boats are made fast. Almost immediately the tide reaches its full height it starts to recede, and it is so marked that when it is out the boats are without water under them. Loaded then on dry land, the boats await the return of the tide and then race to the deep water of the bay.

Building Lighted Airways

IN response to a request from ROCK PRODUCTS, W. D. Kocherspeiger, secretary-treasurer of the Limestone Products Co., Inc., Mifflinsburg, Penn., writing from San Bernardino, Calif., has furnished the following information concerning the new activities of the company. He says:

"We found quarrying to be a little too slow in our part of the country and as a consequence have leased our quarries for the next three years and we are now engaged in installing the lighted airways of the United States for the Department of Commerce to make possible the flying of airships at night in safety, both for the transmission of mail and the carrying of passengers and light express. We have now been engaged in this work for the last three years and find it much better than quarrying the Pennsylvania stones. We possibly have been very fortunate in securing these contracts and up to the present time the work has been profitable as well as extremely pleasant to all of us."

Buttress Company Output of Wallboard Increased in 1926

GYPSUM wallboard production at the Buttress Manufacturing Co., Los Angeles, Calif., has increased 100% during the last year, according to a report in the Los Angeles (Calif.) *Times.* In March, 1926, the company is reported to have made 1,000,000 ft. of wallboard as compared with 2,000,000 ft. produced in March, 1927.

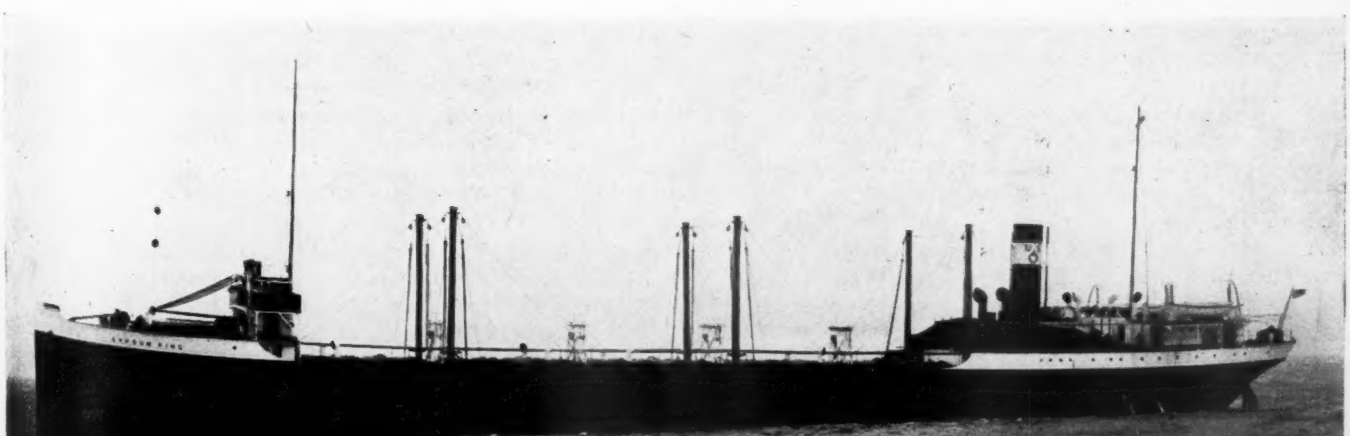
While a large part of the output is utilized in southern California, large quantities of wallboard are shipped to Pacific coast ports and trans-Pacific countries, according to J. H. Clark, secretary-treasurer.

"In order to increase production we have installed $25,000 worth of new drying equipment, giving us one of the largest curing rooms for wallboard in the west," Mr. Clark continued.

Mr. Clark pointed out that where the climate is semi-tropical, as in southern California, wallboard is becoming more and more popular in scientific construction. He said that this is one of the reasons why so much of the product is shipped to foreign centers where atmospheric conditions approach those of the southland.

Lawrence Portland Co. Changes Personnel, Thomaston, Maine, Lime Plant

W. R. PHILLIPS, who has been general manager of the lime plant at Thomaston, Maine, of the New England Lime and Portland Cement Co. and which was taken over by the Lawrence Portland Cement Co., has completed his duties for the company and has been succeeded by D. J. Davis of Allentown, Penn. Mr. Davis is well known to the cement industry, having been connected with various enterprises during a number of years.—*Rockland* (Maine) *Courier-Gazette.*



The "Gypsum King," specially designed gypsum carrier of the United States Gypsum Co., to operate between Nova Scotia and New York

Ohio River Gravel Company Sells Properties

OFFICIALS of the Ohio River Gravel Co., Parkersburg, W. Va., announced recently that they had sold the properties of the company to George Vang, president of the Iron City Sand and Gravel Co. of Pittsburgh. The Ohio River Gravel Co. is one of the largest sand and gravel producers between Pittsburgh and Louisville, operating plants at Marietta, Ohio, New Martinsville, Parkersburg and Wheeling, W. Va. The combined annual output of these plants is estimated at 750,000 tons of washed, screened and graded river sand and gravel for ballast, building purposes, etc.

Charles Corliss of New Martinsville was president of the Ohio River company; E. A. Brast, chairman of its board; G. C. Ross, formerly of this city, vice-president, and A. P. Turley of Parkersburg, secretary-treasurer and general manager. Mr. Turley will continue as manager, it is stated.

The name of the company will be changed to the Ohio River Sand and Gravel Co., with general offices at Parkersburg, W. Va. The consideration was not announced.

Mr. Vang stated that no change in the personnel of the company would take place and that it would not be merged with his Pittsburgh companies. — *Baltimore* (Md.) *American.*

Finish Appraisal of Michigan State Cement Plant

THE Manufacturers' Appraisal Co. is reported to have completed for the state administrative board an appraisal of the state cement plant at Chelsea, Mich., whose value, earning capacity and worth as a prison institution have been a subject of much dispute between the outgoing Groesbeck and the present Green state administration. In its report, the company checks up on the appraisal of the plant during the concluding days of the Groesbeck administration, on which it was claimed that the property, purchased by the state for $500,000, was worth over $1,301,000, and was making money as a going concern.

The new appraisal, it is understood, places a decidedly lower valuation on the plant and inventories, two items in particular being each scaled down by over $100,000 to bring their valuations into harmony with what is claimed to be sound business practice.—*Flint* (Mich.) *Journal.*

Favor Bill for Wisconsin State-Owned Cement Plant

LITTLE opposition in the Wisconsin assembly was shown the bill of Assemblyman William C. Coleman, Socialist, Milwaukee, providing for appointment of a legislative committee by the governor to investigate the feasibility of establishing a state-owned plant for the manufacture of portland cement.

An appropriation of $30,000 for the work of the committee is included in the bill which was engrossed after attempts to kill it had been defeated, 6 to 10.

This sum, or portions of it, could be used for the purchase of options on lands where raw material for the manufacture of cement exists or on available sites for a plant.—*Milwaukee* (Wis.) *Leader.*

Lawrence Portland Pushing Work at Thomaston, Maine, Project

THIRTY-TWO carloads of lumber for the Lawrence Portland Cement Co.'s new plant in Thomaston, Maine, are on their way and many carloads of equipment are expected shortly. Among the equipment already received is a steam shovel and a well drill.

Fifty men are now working on the construction end of the work and it is expected that day and night operations will soon be in progress. Joseph Taylor, the superintendent of construction, is pushing the work as rapidly as possible.

The grading is being done for the new tracks. The first building to go up will be the office, but the machine shop will be the first one completed. Meantime the new ground lime plant is approaching completion and will probably be in operation by May 1. This plant will have a capacity for manufacturing 25 tons of pulverized lime an hour. —*Rockland* (Maine) *Courier-Gazette.*

Action Sought in Bill Allowing New York to Buy Cement Direct

COL. FREDERICK STUART GREENE, superintendent of public works, New York state, is seeking action on a bill given by him to Senator Westall which would permit the state to purchase cement direct from manufacturers for use in highway work. The bill is said to have been allowed to slumber in committee, advised of this by Senator Westall, Colonel Greene has written a tart letter.

"I can hardly credit that the bill will not be reported," writes the colonel. "New York state is the largest single customer for cement in the state. This department will use approximately 3,000,000 bbl. per year. The dealers' commission on this is 10 cents per barrel or $300,000. In addition to this many of our contractors are not able to discount their bills of 10 cents per barrel. If we assume that only half of these contractors can discount, your bill would mean a further saving of $150,000 or a total annual state saving of $450,000.

"I can think of no one who would oppose this bill except a few cement dealers and I can't bring myself to believe that the legislature, to benefit a small group of cement dealers, will annually penalize the 10,000,000 people of this state the approximate sum of $500,000."—*Buffalo* (N. Y.) *News.*

Another Florida Cement Plant?

ACCORDING to information received from Cyrille Careau, Inc., New York, N. Y., a rather interesting transaction has been consummated which will be expected to result in the erection of a large cement mill near Tampa, Fla. Mr. Careau writes:

"It has been generally supposed that the state of Florida did not contain hard rock or hard rock in any quantity. Nearly a year ago it was discovered that near the town of Zephyrhills, Pasco county, about 15 miles north of Tampa, was a hard rock deposit with an inconsequential overburden. The territory surrounding this find was carefully drilled and tested, and it was found that there was a total of about 1100 acres of hard rock. The rock is known as flinty chert, a siliceous lime by composition, and more than meets the most exacting tests for road purposes or mass concrete construction.

"The quarrying which was done on this property disclosed that in addition to this hard rock there was a cement clay, kaolin, fuller's earth, lime rock and other minerals. Exhaustive tests and analyses have been made of the mineral deposits on this land and it is rich in all the necessary components of cement. The quarrying of the hard rock makes available all the other mineral deposits without additional mining cost.

"The immediate result of this discovery of hard rock was the formation of a syndicate which purchased and took title to the property. Among those in the syndicate are: Amos R. E. Pinchot of New York, brother of Governor Pinchot; Francis Dolan, originally of Minneapolis, who has been identified in the last year with several successful real estate developments in Florida; Walter Dolan, his brother, whose recent business interests have been in Florida in stone quarrying and road construction; John Sinclair, a Chicago capitalist, and myself. The plans of the syndicate as to the development of this property have not been entirely completed, but negotiations are pending looking forward to the disposal of the hard rock for road ballast, road construction and building purposes, and tentative financial arrangements are being made for the purpose of erecting a cement plant to utilize the other mineral resources of this property. It is so situated that it has direct rail connections with both the Seaboard railroad and the Atlantic Coast line.

"Several proposals have been made to lease the property to take out the hard rock on the top for road building, railroad ballast, mass concrete, etc., and we have also been approached by the cement interests, as we have available in this tract and other tracts all the necessary components, we are told, for high grade cement. Whether we shall lease out the property, disposed of it in some other manner or organize a large corporation with the idea of erecting a stone crushing and a cement plant is a matter that the future will decide. As a matter of fact we are quite open to suggestions."

Bernard L. McNulty Becomes the President of the New England Lime Co.

BERNARD L. McNULTY, president of the Marblehead Lime Co., Chicago, Ill., has been elected president, also, of the New England Lime Co., Pittsfield, Mass., succeeding the late J. King McLanahan, Jr. Mr. McNulty was formerly vice-president of the New England Lime Co., and Mr. McLanahan was treasurer of the Marblehead Lime Co. The associated companies are probably the largest manufacturers of chemical lime in this country, if not in the world.

Bernard L. McNulty

Mr. McNulty began his acquaintance with the lime industry as a member of the staff of ROCK PRODUCTS, in the day of Edgar Defebaugh and Fred Irvine. From an intimate view of the lime industry through this contact Mr. McNulty early sensed it as fundamentally sound and with a bright future for a young man. His subsequent career in the lime industry has amply justified his business judgment and discernment as well as his ability and his industry.

Mr. McNulty, incidentally, is a fine example of the quiet, modest, scholarly type of big business executive—the type that is coming more and more to the front in all lines of industry; because the complications, intricacies and requirements of modern business call for brains rather than bluster, which characterized many of the captains of industry in times past.

C. C. Loomis, of Loomis, Stump and Bank, consulting chemists, New York City, has been appointed assistant to the president of the New England Lime Co., and will have charge of operating and chemical departments. Mr. Loomis is a graduate of Harvard University, and a world war veteran, who achieved distinction in the chemical warfare branch of the A. E. F.

Hoosac Valley Lime Corporation to Expand Plant

A RECENT report in the Springfield (Mass.) *Republican* states that plans for the enlargement of the Hoosac Valley Lime Corp., Adams, Mass., a subsidiary of the Rockland-Rockport Lime Corp., have been announced by W. F. Flaherty, president of the company. The capacity will be increased by at least 1000 bbl. per day, the report states. This is equivalent to about five times the present output.

New kilns to provide the increased capacity will be installed and other construction includes concrete and steel mill buildings. Changes at the quarry consist in part of the replacement of the 15-hp. electric motor in use by one of 60-hp. Contract for the construction of the kilns is said to have been awarded to the Traylor Engineering and Manufacturing Co., Allentown, Penn. These kilns, it is rumored, will be of the rotary type.

The Lime Convention

FOR the first time in several years the annual convention of the National Lime Association will be a wide-open meeting for the whole lime industry—non-members as well as members. It is to be hoped, for the good of the lime industry, that *all* lime manufacturers accept the invitation of the National Lime Association to take part in these discussions.

The leaders in the industry have frankly decided the situation is such that it is desireable to start all over again, "from the ground up," and there is no reason why any member, ex-member or non-member should hesitate to accept the invitation to take part in this conference.

White Sulphur Springs, W. Va., is a delightful spot at this season of the year. It is easy of access from almost any direction. By holding the convention here there will be no side attractions such as presented by night life in the big cities, and there is no reason why the entire time of the convention should not be devoted to sober and serious consideration of the past, present and future of the American lime industry.

The date of the convention is May 17, 18 and 19, at the Greenbrier hotel. The convention will begin with a luncheon on Tuesday, May 17. All day Wednesday, May 18, will be given over to a free-for-all discussion of the two big problems of the lime industry—"Promotion" and "Selling." Presumably the session on Thursday, May 19, will decide the fate of the lime association, and to some extent at least the future of the lime industry.

Entrance to the Greenbrier hotel, White Sulphur Springs, W. Va., where the National Lime Association convention will be held on May 17, 18, 19

Myerstown Company to Operate New Hydrate Unit

A REPORT in the Lebanon (Penn.) *News* states that the Myerstown Hydrated Lime Co. has nearly completed its new hydrating plant at the Ebling quarry, east of Lebanon. Operations are expected to begin about May 1. The unit will have a capacity of 25 tons of lime hydrate per day.

The company, which comprises John Ebling and Earl E. Wilhem, will continue the production of stone for other than lime burning at its quarry, it is said.

Porter Company's New Plant at Lobert, Oregon, Completed

ACCORDING to the Klamath Falls (Ore.) *News*, the new Lobert, Ore., sand and gravel plant of the Porter Construction Co. is now ready to go into operation. The capacity of the plant is given at about 200 yd. per day.

The entire plant will be electrically operated. A stretch of standard gage track, one-quarter mile in length, has been placed from the pit to a Southern Pacific siding, where cars will be loaded out for shipment throughout the Klamath basin. Gasoline locomotives will be used to haul the cars between the pit and the siding.

The entire output from the plant, according to Louis Porter, president of the company, will be consumed in this section of the country, both for the Klamath Falls heavy construction volume and for Chiloquin and other outlying districts in the state.

North Adams, Mass., Business Men Reject Proposal for Local Cement Mill

AFTER careful consideration, apparently from all angles, the North Adams, Mass., Chamber of Commerce has decided that while a cement mill may be a lucrative and desirable addition to any community, it has no charms, financially speaking, for their city. Consequently, it has recently rejected a promotion scheme to build such a mill at that city. That the proposition had many proponents, particularly among the press, may be gathered from the following notice clipped from a local newspaper:

"Faxon Bowen's proposition of establishing a cement industry in this city has been rejected by the North Adams Chamber of Commerce because influential men of the organization did not believe it could be financed. They had no definite information to offer banking houses which would support the project. It was just for such information that caused Mr. Bowen to intimate through communications in the local paper that $2500 would do the job. Mr. Bradley did not withdraw after promising financial support, but in a way dropped out of the picture when he left his investment to the judgment of a Chamber of Commerce committee. The $2500 would probably have been used in securing data that would give assurance of a backing to keep things in operation.

"Apparently Mr. Bowen was not 'bluffing,' for he has practically completed arrangements to establish this same new industry less than 20 miles from the city limits and it surely looks as if one of the neighboring towns is to be benefited by a big proposition. Creation of freight handling by the Boston and Maine railroad brings about another idea of encouragement for the construction of a cement manufacturing company in these parts. Should the plan prove a big success, North Adams has no right to feel hurt about it, for the city had an option on the proposition. Developments in the south end of the city were forthcoming and it first appeared as if there would be some real cause which would provide for the removal of the Arnold Print Works dam in the Hoosac river to the north of Phoenix bridge. Now wouldn't it be great to see construction of homes along the flats of lower State street? It would, but this generation is too old to witness any such reform.

"It is not generally known that plans were being made for a cement factory here. The public knew that Mr. Bowen was trying to start something which would result in further development of the city. He figured that the cost per barrel of producing portland cement at North Adams was as follows: Mining or quarrying rock and clay, 20c; mixing and crushing 15c; calcining, 30c; milling clinker, 40c; bagging, 15c; shipping, 5c, and non-productive labor, 25c, making a total of $1.50 a barrel or 37½c per bag. The cost of building and equipment figured slightly over $750,000, including pulverizing plant for coal. Working capital, according to an estimate of Allis-Chalmers of New York City, was placed at $150,000, while the cost of financing, promoters' profits, legal services, etc., was placed at $500,000. This called for approximately $1,500,000 upon which the project would have been called upon to earn 7% in order to be an attractive investment. Proposed production was estimated at 300,000 bbl. a year. In order to dispose of this quantity of cement a year it would have been necessary to sell into Vermont, New Hampshire and Massachusetts only about 7% of the cement shipped into that territory in 1926, exclusive of imports. The North Adams project would beat freight rates into Boston so that it is safe to say profits would have been worth while, especially in an intermediate territory. Estimating a flat profit of 50c per barrel, it would leave $45,000 a year for dividend requirements. These are facts obtained after long study.

"The above mentioned items resound of real money, but the Chamber of Commerce could not see it."

Promoting an Arkansas Cement Project

THE citizens of Foreman, Ark., are very much enthused over the prospects at this time for the erection of a cement plant at this place in the near future. The *Foreman* (Ark.) *Sun* gives the following account of the activities in regard to the promotion of the plant:

"A representative of the American Portland Cement Co., in company with a party of railroad men and construction engineers, arrived in the city Sunday, April 9, and spent several days here looking over the property and making estimates to be submitted to the company.

"The party of Frisco officials was composed of J. B. Hilton, St. Louis, industrial commissioner; H. M. Booth, Ft. Smith, assistant engineer, and J. G. Weaver, Ft. Smith, division freight agent. Other members of the party were Col. Leigh Hunt, president of the Hunt Engineering Co. of Kansas City; Geo. J. Trombold, industrial engineer for the same company; John P. Streepey, Little Rock, and Jas. H. Williams of Ashdown, counsel for the American Portland Cement Co.

"L. L. Griffith of Ann Arbor, Mich., a mechanical engineer; J. B. Harbison, a representative of the O. B. Avery Co., makers of construction equipment, and Clay Oxford of New York arrived Tuesday.

"The railroad officials have made the survey for the immediate construction of a spur leading to the property of the company, and the purpose of the visit of the other engineers is to submit bids on the construction of the plant.

"The construction of the railroad switch will necessarily be the first steps taken before construction work can be started.

"The party was given a very cordial reception and the glad hand of welcome at a banquet in the dining room of the Gathright Hotel Monday at noon by the business men of the town, which was one of the most enjoyable events that has occurred in Foreman in some time. The meeting was opened by singing one verse of America. Dr. L. C. Shackelford returned thanks, after which the serving of a very sumptuous meal was begun.

"The meeting was presided over by Dr. Herman Castile as toastmaster, and he proved himself equal to the occasion.

"The chairman called on C. E. Oxford for a talk, stating that the people of Foreman were ready and willing to co-operate with his company if he would only tell us what to do. Mr. Oxford replied that he only wanted the moral support of the community for his company, as he had no stock-selling or other money-raising scheme in his system. He stated that he had labored very hard in arriving at the point where he now is, stating that he had had many obstacles to overcome which we knew nothing about, and which he had to fight alone.

"Other speakers called on were Col. Hunt, who confined his remarks to 'gas'—the kind, however, that burns—the many conveniences to the home, and the wonderful possibilities it affords. Col. Hunt congratulated our community on its display of civic pride.

"J. B. Hilton, industrial agent for the Frisco, made a very interesting talk. His remarks were on the 'trade at home' idea of building a state, county or town, and closed with the admonition to 'know your home town first.'

"T. H. Duke, Jr., cashier of the Merchants and Planters Bank, made a few remarks of welcome and assured the visitors of our hearty co-operation in the undertaking.

"Mr. Trumbold, Attorney Streepey, James H. Williams and Judge W. D. Waldrop also made short talks. All the talks were short and spicy and were very much enjoyed.

"The dinner was also a most enjoyable feature of the occasion, being served under the personal supervision of Mrs. W. M. Gathright, who is an expert at such occasions. Following is the menu:

Grape Fruit Cocktail — Cream of Celery Soup
Lettuce and Tomato Salad — Olives
Spring Chicken — Cream Gravy
Cream Potatoes — Sifted French Peas
Hot Rolls
White Mountain Cake — Ice Cream
Demi-Tasse

"This is all the information Mr. Oxford furnished the *Sun* man for publication this week, but we will endeavor to keep our readers informed as development proceeds.

"A deal was closed Wednesday night for a location for the plant, when Mr. Oxford purchased 80 acres of land from Sam Seligson, adjoining the holdings of the company. We are reliably informed that the railroad company will begin construction on the spur as soon as weather conditions permit."

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

A Pioneer in Cement Pipe Manufacturing

Knoxville, Tennessee, Plant of the Shearman Concrete Pipe Co., at Which Manufacturing Methods Used at 10 Other Shearman Plants Were Developed

THE Shearman Concrete Pipe Co., which has its main office at Knoxville, Tenn., is perhaps the best known maker of concrete pipe in the country. It has plants at ten different cities in the southeastern states under one organization, and there are two plants west of the Mississippi, at Dallas, Texas, and Little Rock, Ark., known as Shearman Concrete Pipe companies which operate as independent organizations.

The Knoxville plant was the first built and does not have the fine appearance of some of the later plants such as those at Atlanta, Ga., and Tampa and Jacksonville, Fla. But there is a certain interest attached to this plant which the others do not have, because it was the parent plant, and the methods which are used in all the other plants were developed here.

A. N. Shearman, who has now retired from the business, started it when he lived in Athens, Tenn. He had little but an idea to begin on, but that idea was a most important one. He was convinced that the concrete pipe, from the cheapness with which it could be made, and the fact that the greater part of the necessary material (the aggregate) was obtainable almost everywhere, would have a great future as railroad and highway culvert pipe and in drainage and sewerage work. He tried to induce friends with money to go into the business with him, but they could not see the possibilities of concrete pipe as he saw them. One of them, however, was willing to lend him some money with which to try out his idea, and Mr. Shearman worked long enough in Athens to convince himself that he was right and to convince others who had the capital. The business was moved to Knoxville where a good sized plant was erected so that production could be entered into on a large scale.

Branched sewer pipe made at Shearman plant

There are really two plants at Knoxville, one for sewer pipe, in charge of T. B. Arp, and one for highway and railway culvert pipe in charge of F. A. Hamley. E. W. Lauthner is manager of both.

Many Sizes Made

All sizes of pipe from 6-in. to 78-in. are made. The sizes up to 36 in. are made on machines and the larger sizes are poured by hand. The machines used are the Tuerk-MacKenzie machine, made in Portland, Ore., and the Easterday machine, made in Terre Haute, Ind. Blystone mixers are used with these machines and a double cone mixer of the type generally used in concrete construction mixes the concrete for the hand-made pipe.

All except the smaller sizes of pipe are reinforced. The reinforcing material is a web or screen with meshes about 6 in. square, made by electrically welding the cross-wires to the longitudinal wires. This comes in large rolls and in widths corresponding to the various lengths of pipe. It is cut off the right length and put through bending rolls to shape it to the size for

Shearman Concrete Pipe Co., Knoxville, Tenn. Left—The sewer pipe plant showing the kilns of concrete block with reinforced roofs. Right—Curing room end of plant in which highway and railroad culvert pipe are made

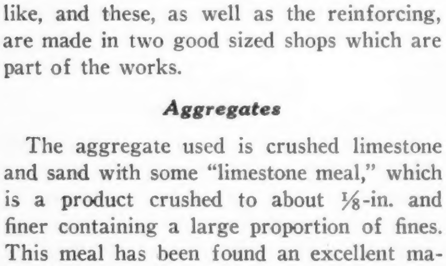
This culvert, tested for specification requirements, withstood the load without measurable deflection

the pipe required and the ends are fastened by electrical spot welding. The completed reinforcing is a cylinder true to shape and of just the right size.

This concern is so large that it pays for it to make its own molds, pallets and the like, and these, as well as the reinforcing, are made in two good sized shops which are part of the works.

Aggregates

The aggregate used is crushed limestone and sand with some "limestone meal," which is a product crushed to about 1/8-in. and finer containing a large proportion of fines. This meal has been found an excellent material to use as a filler, reducing the permeability of the pipe and also helping to keep the mixture plastic with a low water-cement ratio. The limestone used comes from the American Limestone Co. at Mascot, and it is the tailings from the operation of a mill crushing zinc ore. It is crushed to 5/8-in., 3/8-in. and meal sizes for use in this concrete pipe making. The coarser sizes are usually given the miner's name, which is "chats."



T. B. Arp, in charge of the sewer pipe plant

The aggregate is measured to the mixer in ordinary galvanized 10-quart iron pails which are heaped full and struck off to make sure that the measure is correct. The mix used for one charge of the Blystone mixer when the writer was present was seven pails of 3/8-in. "chats," six pails of sand and one sack of cement. The sand is bought from the regular sand producers at Knoxville.

Water is added so that the mass retains the shape in which it is left when it is squeezed in the hand, the amount added varying a little according to the moisture in the sand. The mixing time is three minutes, and careful tests have shown that with this aggregate and cement there is no gain in strength from mixing longer than three minutes.

Pipe Machinery

Only the Tuerk-MacKenzie machines were working when the plant was visited. These have a large revolving cast-iron plate with lugs which hold the cast-iron pallet in a central position. This pallet has a groove for holding the reinforcing in place and a rabbet into which the mold fits. This mold is of the usual hinged type which fastens with a clamping lock. The inside surface of the pipe is formed on a stationary cylinder which is let down into the mold before filling begins.

The mold is filled from a hopper, to which the mixture has been elevated from the Blystone mixer. The mixture runs rather slowly through a gate and chute to allow the tampers to pound it thoroughly into place as the mold is filled. The tampers are iron shoes on the ends of wooden sticks about 3 in. wide and 1/2-in. thick. There are two of them, one working on either side of the reinforcing. They strike very rapid blows, the strength of which is determined by the friction given a screw clamp through which they pass. As the mold is filled the stick is forced through the clamp, and to keep it filling evenly and to make sure the tamping is the same all the way, the man in charge occasionally adjusts the screw of the clamp. When the filling is completed, the mold for forming the end is troweled off and the cylinder on the inside is raised so that the mold can be rolled off the plate. An ingenious feature of this machine is a scraper on this plate which takes off any of the mixture that is spilled as the mold is filling and returns it to the elevator which fills the hopper.

Curing

The molds are taken to the curing rooms (or kilns) in a specially designed truck made

E. W. Lauthner, manager of the Knoxville plant, standing in a 78-in. pipe joint

in the shops of the plant. The molds are stripped, leaving the pipe standing on the pallet. After 24 hours of steam curing the pipe can be removed from the pallets and taken to the rooms in which they are packed closely for final curing. In the steam room live steam is admitted and the regulation is by keeping the boiler pressure at 5 lb. The temperature is around 110 deg. F. In the other curing rooms fog nozzles are used to admit water in the form of a mist. These rooms have steam pipes which are part of a regular heating system to keep the temperature steady regardless of weather conditions.

There are six of these curing rooms at each plant and each room is about 75 ft. long and 20 ft. wide. The sides are of concrete block, chosen for its good insulating qualities, and the roof is of reinforced con-

crete. The block used were made by the company, which makes them for its own constructions but does not sell them.

The making of the larger sizes of pipe by hand filling the mold and hand tamping is carried on in a shed which is provided with roll-ways, chain blocks and other conveniences for handling the heavy molds. The molds have both internal and external forms of steel plate, both made at the plant. The interior forms are closed with jaw rings to prevent the plates being pushed inwardly by the pressure of the concrete.

Another kind of hand work which is very interesting to watch is that of making the branches used in sewer lines. These branches are used with bell and spigot pipes and the take off piece is at 45 deg. to the center line of the pipe. The branch is made by taking a joint of pipe made in the regular way and cutting an elliptical hole in the side, while it is still soft, with an ordinary keyhole saw. The branch piece is cast by hand in a special mold. It fits into the elliptical hole with a thin section. It is held firmly in place and then freshly mixed concrete mortar is built up around the joint and troweled smooth. The cost of one of these branch pieces is rather more than 5 times the cost of a straight joint, owing to the handwork that must be done.

Pipe Conforms to Specifications

All pipes are made to conform to the American Society for Testing Materials' specifications for concrete pipe, plus an additional 25% in strength for the spigot and bell pattern. The highway culvert pipes must conform to the specifications for strength in the states for which they are sold. In Tennessee they must support 1800 lb. per lineal foot times the diameter of the pipe, and in Kentucky, 1500 lb. per ft. times the diameter. These highway culverts are made with flush joints. One of the pictures shows a culvert constructed of this pipe, with the usual wings, which was tested to prove the strength of the joints by piling a balanced load of sacks of cement on planks laid upon it. It stood something more than the weight required by the specifications without any deflection that the engineers who conducted the test were able to measure.

There are several acres of ground about the plants which are used for the storage of pipe. It looks like an immense stock, but it is none too large. Only a short time before the plant was visited to obtain the notes for this story, orders came in so fast that the yard was almost cleared, and it had only just got back into shape when the pictures accompanying this article were made.

The officers of the Shearman Concrete Pipe Co. are: F. L. Conner, president; H. E. Murphy, vice-president and general manager, and J. C. Teague, secretary and treasurer. E. W. Lauthner is manager of the Knoxville branch.

Northwest Products Association Gives Out Quality Seals

THE Northwest Concrete Products Association recently awarded its "Certificate of Quality" No. 1 to the Concrete Pipe Co., and No. 3 to the Collins Concrete Co., both for concrete sewer pipe. Both companies are located in Portland, Ore.

These certificates of quality are the results of crushing and hydrostatic tests made by F. R. Zaugg, executive secretary of the association, and satisfactorily passed. The tests were made before Oscar Beck, of the city of Portland testing laboratories. The certificates are signed by W. H. Sharp of Longview, association president; J. J. Collins of Portland, secretary, and F. R. Zaugg.

Products of other manufacturers will be tested as rapidly as possible, according to President Sharp.

At its annual meeting in Seattle in January the Northwest Concrete Products Association adopted specifications for testing various concrete products and awarding certificates of quality to those passing tests, with a view of maintaining quality concrete products among all members of the association. The certificates will be framed and exhibited in the office of each association member holding them, for the protection of those buying concrete products.—*Portland* (Ore.) *Journal of Commerce.*

Decorative Effects Produced With Inlaid Colored Cement on Stucco Walls

A DISTINCTIVE decorative effect for stucco walls or floors of dwellings has just been developed by the National Inlaid Colored Cement Corp., Los Angeles, Calif. This new feature is applied as follows: When the finishing coat of stucco or cement is in a wet state and before it sets the colors, mixed with only cement, sand and water, also in a wet state, are laid out according to the design desired and then pressed into the wall or floor without running colors together. The designs, quite similar to the old Mosaics, are permanent and will last a lifetime, according to the producers. In addition to Spanish, Moorish and modern designs, the tile and art stone effect is produced.

The National company will also manufacture inserts attached to metal lath, which may be installed without difficulty.—*Los Angeles* (Calif.) *Journal of Comerce.*

Part of the storage yard, showing some of the highway culvert stock, on a low hillside near the Shearman Concrete Pipe Co. plant at Knoxville, Tenn.

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F.O.B., at producing point or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Buffalo, N. Y.	1.30	1.30	1.30	1.30	1.30	1.30
Chaumont, N. Y.	.50	1.75	1.75	1.50	1.50	1.50
Chazy, N. Y.	.75	....	1.60	1.30	1.30	1.30
Coldwater, N. Y.—Dolomite	1.50 all sizes					
Danbury, Conn.	2.25	2.25	2.00	1.75	1.50	....
Dundas, Ont.	3.04	1.05	1.05	.90	.90	.90
Frederick, Md.	.50@ .75	1.20@1.30	1.15@1.25	1.10@1.15	1.10@1.15	1.05@1.10
Munns, N. Y.	1.00	1.50	1.50	1.40	1.25	1.25
Northern New Jersey	1.60	1.50@1.80	1.30@2.00	1.40@1.60	1.40@1.60	....
Prospect, N. Y.	1.00	1.50	1.40	1.30	1.30	....
Walford, Penn.	.70	....	1.35h	....	....	....
Watertown, N. Y.	1.00	....	1.75	1.50	1.50	1.50
Western New York	.85	1.25	1.25	1.25	1.25	1.25
CENTRAL						
Alton, Ill.	1.85	....	1.85	....	....	....
Buffalo, Iowa	1.10	....	1.50	1.30	1.35	1.35
Chasco, Ill.	1.00@1.30	....	1.00@1.15	....	1.00@1.15	....
Columbia, Krause, Valmeyer, Ill.	1.10@1.50	1.10@1.25	1.20@1.35	1.10@1.35	1.10@1.35	‖1.25
Flux (Valmeyer)	1.10@1.50	....	....	1.75	....	1.75
Greencastle, Ind.	1.25	1.25	1.15	1.05	.95	.95
Lannon, Wis.	.80	1.00	1.00	.90	.90	.90
Linwood and Buffalo, Iowa	1.10	....	1.50	1.30	1.35	1.35
McCook, Ill.	1.00	1.25	1.25	1.25	1.25	1.25
River Rouge, Mich.	1.20	1.20	1.20	1.20	1.20	1.20
Milltown, Ind.	....	.90@1.00	1.00@1.10	.90@1.00	.85@ .90	.85@ .90
Montreal, Que.	.90	1.35@1.45	1.15	.95	.90	.90
Mt. Vernon, Ill.	1.10@1.20	1.00	1.00	1.00	1.00	....
Sheboygan, Wis.	1.10	1.10	1.10	1.10	1.10	1.10
Stone City, Iowa	.75	....	1.25	1.10	1.00	....
Toledo, Ohio	1.60	1.70	1.70	1.60	1.60	1.6[illegible]
Toronto, Ont.	1.55	2.05	2.05	1.90	1.90	1.90
Waukesha, Wis.	.90	.90	.90	.90	.90	....
Wisconsin Points	.50	....	1.00	.90	.90	....
Youngstown, Ohio	.70j	1.25l@1.35h	1.25l@1.35h	1.25l@1.35h	1.25l@1.35h	1.25l@1.35h
SOUTHERN:						
Alderson, W. Va.	.40	1.45	1.35	1.25	1.20	....
Atlas, Ky.	.50	1.00	1.00	1.00	1.00	1.00
Brooksville, Fla.	.75	....	2.65	2.65	2.40	2.00
Cartersville, Ga.	1.50	1.50	1.80	1.35	1.15	1.15
Chico, Tex.	1.00	1.35	1.25	1.20	1.10	1.00
El Paso, Tex.	1.00	1.00	1.00	1.00	....	....
Ft. Springs, W. Va.	.50	1.35	1.35	1.20	1.20	....
Graystone, Ala.	.50	Crusher run, screened, $1 per ton				
Kendrick and Santos, Fla.	3½ in. and less, 1.00 per ton					
Ladds, Ga.	....	1.65	1.65	1.35	1.15	1.15
New Braunfels, Tex.	.60	1.25	1.10	.90	.90	.90
Rocky Point, Va.	.50@ .75	1.40@1.60	1.30@1.40	1.15@1.35	1.10@1.20	1.00@1.05
WESTERN:						
Atchison, Kans.	.50	1.90	1.90	1.90	1.90	1.80
Blue Springs & Wymore, Neb.	25	1.45	1.45	1.35c	1.25d	1.20
Kansas City, Mo.	1.00	1.60	1.60	1.60	1.60	1.60
Cape Girardeau, Mo.	1.25	1.25	1.25	1.25	1.00	....
Rock Hill, St. Louis Co., Mo.	1.45	1.45	1.45	1.35	1.35	1.35

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Branford, Conn.	.80	1.70	1.45	1.20	1.05	....
Duluth, Minn.	.90	2.25	1.90	1.50	1.35	1.35
Dwight, Calif.	1.00	1.00	1.00	.90	.90	....
Eastern Maryland	1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts	.85	1.75	1.75	1.25	1.25	1.25
Eastern New York	.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania	1.10	1.70	1.60	1.50	1.35	1.35
Knippa, Texas	2.50	2.00	1.55	1.25	1.15	....
New Haven, New Britain, Meriden and Wallingford, Conn.	.80	1.70	1.45	1.20	1.05	1.05
Northern New Jersey	1.40	2.00	1.80	1.40	1.40	....
Oakland and El Cerito, Cal.	1.00	1.00	1.00	.90	.90	....
Richmond, Calif.	.75	....	1.00	1.00	1.00	....
San Diego, Calif.	.70	2.00	1.50	....	1.25	1.25
Springfield, N. J.	1.70	2.20	2.15	1.70	1.70	....
Toronto, Ont.	....	3.58@4.05	3.05@3.80	....	....	....
Westfield, Mass.	.60	1.50	1.35	1.20	1.10	....

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Berlin, Utley, Montello and Red Granite, Wis.—Granite	1.80	1.70	1.50	1.40	1.40	....
Columbia, S. C.—Granite	....	2.00	1.75	1.75	1.60	....
Eastern, Penn.—Sandstone	1.35	1.70	1.65	1.40	1.40	1.40
Eastern Penn.—Quartzite	1.20	1.35	1.25	1.20	1.20	1.20
Emathla, Fla.	Crushed flint rock, 2.50 per cu. yd.					
Lithonia, Ga.	.75a	2.00b	1.75	1.40	1.35	1.25
Lohrville, Wis.—Granite	1.65	1.70	1.65	1.45	1.50	....
Middlebrook, Mo.	3.00@3.50	....	2.00@2.25	2.00@2.25	....	1.25@3.00
Richmond, Calif.—Quartzite	.75	....	1.00	1.00	1.00	....
Rochester, N. Y.	Dolomite all sizes $1.50 per ton					
Somerset, Penn. (sand-rock)	1.50 to 1.85					
Toccoa, Ga.	....	1.35	1.35	1.30	1.25	1.25

*Cubic yd. †1 in. and less. ‡Two grades. ‖Rip rap per ton. (a) Sand. (b) to ⅛ in. (c) 1 in., 1.40. (d) 2 in., 1.30. (e) Dust. (f) ¼ in. (h) less 10c discount. (i) 1 in., 1.40. (j) Less 10% net ton. (l) Less .05.

Agricultural Limestone

(Pulverized)

Alderson, W. Va.—Analysis, 90% $CaCO_3$; 50% thru 50 mesh	1.50
Alton, Ill.—Analysis 99% $CaCO_3$, 0.3% $MgCO_3$; 90% thru 100 mesh	6.00
Asheville, N. C.—Analysis, 57% $CaCO_3$, 39% $MgCO_3$; 50% thru 100 mesh; 200-lb. burlap bag, 4.00; bulk	2.75
Atlas, Ky.—90% thru 100 mesh	2.00
50% thru 100 mesh	1.00
Bettendorf and Moline, Ill.—Analysis, $CaCO_3$, 97%; 2% $MgCO_3$; 50% thru 100 mesh, 1.50; 50% thru 4 mesh	1.50
Blackwater, Mo.—100% thru 4 mesh	1.00
Branchton and Osborne, Penn.—100% thru 20 mesh; 60% thru 100 mesh; 45% thru 200 mesh. (Less 50 cents commission to dealers)	5.00
Cape Girardeau, Mo.—90% thru 50 mesh	1.50
Charleston, W. Va.—Marl, per ton, bulk	3.00
Chaumont, N. Y.—Pulverized limestone, bags, 4.00; bulk	2.50
Chico, Tex.—50% thru 50 mesh, 1.75; 50% thru 100 mesh	2.25
Colton, Calif.—Analysis 90% $CaCO_3$, bulk	4.00
Cypress, Ill.—90% thru 100 mesh	1.35
Ft. Springs, W. Va.—50% thru 4 mesh	1.50
Hillsville, Penn.—Analysis, 94% $CaCO_3$, 1.40% $MgCO_3$; 75% thru 100 mesh; sacked	5.00
Hot Springs and Greensboro, N. C.—Analysis, $CaCO_3$, 98-99%; $MgCO_3$, 42%; pulverized; 67% thru 200 mesh, bags	3.95
Bulk	2.70
(Paving dust)—80% thru 200 mesh, bags	4.25@ 4.75
Bulk	3.00@ 3.50
Jamesville, N. Y.—Analysis, 89.25% $CaCO_3$; 5.25% $MgCO_3$; pulverized, bags, 4.25; bulk	2.75
Joliet, Ill.—Analysis, $CaCO_3$, 55%; $MgCO_3$, 45%; 90% thru 100 mesh	3.50
Knoxville, Tenn.—80% thru 100 mesh, bags, 3.95; bulk	2.70
80% thru 200 mesh, bags, 4.25; bulk	3.00
Ladds, Ga.—Analysis, $CaCO_3$, 64%; $MgCO_3$, 32%; pulverized; 50% thru 50 mesh	1.50@ 2.75
Marblehead, Ohio—Analysis, 83.54% $CaCO_3$, 14.92% $MgCO_3$; 60% thru 100 mesh; 70% thru 50 mesh; 100% thru 10 mesh; 80 lb. paper sacks, 5.00; bulk	3.50
Marlbrook, Va.—Marl, per ton, bulk	2.25
Marion, Va.—Analysis, 90% $CaCO_3$, pulverized, per ton	2.00
Middlebury, Vt.—$CaCO_3$, 99.05%; 50% thru 200 mesh; sacked	5.50
Milltown, Ind.—Analysis, 94.50% $CaCO_3$, 33% thru 50 mesh, 40% thru 50 mesh; bulk	1.35@ 1.60
Olive Hill, Ky.—90% thru 4 mesh	1.00
Piqua, Ohio—Total neutralizing power 95.3%; 99% thru 10, 60% thru 50; 50% thru 100	2.50@ 2.75
100% thru 10, 90% thru 50, 80% thru 100; bags, 5.10; bulk	3.60
99% thru 100, 85% thru 200; bags, 7.00; bulk	5.50
Rocky Point, Va.—Analysis, $CaCO_3$, 95%; 50% thru 200 mesh, burlap bags, 3.50; paper, 3.25; bulk	2.00
Syracuse, N. Y.—Analysis, 89% $CaCO_3$; $MgCO_3$, 4%; bags, 4.25; bulk	2.75
Toledo, Ohio, 30% through 50 mesh	2.25
Waukesha, Wis.—90% thru 100 mesh, 4.50; 50% thru 100 mesh, 2.30; 90% thru 50 mesh	1.65
Watertown, N. Y.—Analysis, 96-99% $CaCO_3$; 50% thru 100 mesh; bags, 4.00; bulk	2.50
West Stockbridge, Mass.—Analysis 90% $CaCO_3$, 50% thru 100 mesh; cloth bags, 4.75; paper, 4.25; bulk	3.25

Agricultural Limestone

(Crushed)

Alton, Ill.—Analysis 99% $CaCO_3$, 0.3% $MgCO_3$; 50% thru 4 mesh	3.00
Atlas, Ky.—90% thru 4 mesh	1.00
Bedford, Ind.—Analysis, 98.5% $CaCO_3$, 0.5% $MgCO_3$; 90% thru 10 mesh; 25% thru 100 mesh; 50% thru 50 mesh	1.50
Brandon and Middlebury, Vt.—Pulverized, bags, 5.50; bulk	[illegible]

(Continued on next page.)

Agricultural Limestone

Bridgeport and Chico, Texas—Analysis, 94% $CaCO_3$, 2% $MgCO_3$; 100% thru 10 mesh		1.75
50% thru 4 mesh		1.50
Chicago, Ill.—50% thru 100 mesh; 90% thru 4 mesh		.80
Columbia, Krause, Valmeyer, Ill.—Analysis, 90% $CaCO_3$; 100% thru 4 mesh	1.10@	1.50
Cypress, Ill.—90% thru 50 mesh, 50% thru 100 mesh, 90% thru 50 mesh, 90% thru 4 mesh, 50% thru 4 mesh		1.35
Danbury, Conn.—Analysis, 79% $CaCO_3$, 11% $MgCO_3$; 60% thru 100 mesh; 80% thru 50 mesh; 100% thru 4 mesh; bags, 4.25; bulk		3.25
Dundas, Ont.—Analysis, 54% $CaCO_3$; $MgCO_3$, 43%; 50% thru 50 mesh		1.00
Ft. Springs, W. Va.—Analysis, 90% $CaCO_3$; 90% thru 50 mesh		1.50
Kansas City, Mo.—50% thru 100 mesh		1.00
Lannon, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$; 99% through 10 mesh; 46% through 60 mesh		2.00
Screenings (¼ in. to dust)		1.00
Marblehead, Ohio.—Analysis, 83.54% $CaCO_3$, 14.92% $MgCO_3$, 32% thru 100 mesh; 51% thru 50 mesh; 83% thru 10 mesh; 100% thru 4 mesh (meal) bulk		1.60
Mayville, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$; 50% thru 50 mesh	1.85@	2.35
McCook, Ill.—90% thru 4 mesh		.90
Middlepoint, Bellevue, Kenton, Ohio; Monroe, Mich.; Huntington and Bluffton, Ind.—Analysis, 42% $CaCO_3$, 54% $MgCO_3$; meal, 100% thru 4 mesh; 20% thru 100 mesh		1.50
Moline, Ill., and Bettendorf, Iowa—Analysis, 97% $CaCO_3$, 2% $MgCO_3$; 50% thru 100 mesh; 50% thru 4 mesh		1.50
Mountville, Va.—Analysis, 62.54% $CaCO_3$; $MgCO_3$, 35.94%, 100% thru 20 mesh; 50% thru 100 mesh bags		5.50
Pixley, Mo.—Analysis, 96% $CaCO_3$; 50% thru 50 mesh		1.25
50% thru 100 mesh; 90% thru 50 mesh; 50% thru 50 mesh; 90% thru 4 mesh; 50% thru 4 mesh		1.65
River Rouge, Mich.—Analysis, 54% $CaCO_3$, 40% $MgCO_3$; bulk	.80@	1.40
Stone City, Iowa.—Analysis, 98% $CaCO_3$; 50% thru 50 mesh		.75
Tulsa, Okla.—Analysis $CaCO_3$, 86.15%, 1.25% $MgCO_3$, all sizes		1.25

Pulverized Limestone for Coal Operators

Hillsville, Penn., sacks, 4.50; bulk		3.00
Joliet, Ill.—Analysis, 55% $CaCO_3$; 45% $MgCO_3$; 95% thru 100 mesh		3.50
Piqua, Ohio, sacks, 4.50@5.00 bulk	3.00@	3.50
Rocky Point, Va.—82% thru 200 mesh, 2.50@3.50 bulk, paper bags	3.75@	4.75
Waukesha, Wis.—90% thru 100 mesh, bulk		4.50

Glass Sand

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

Berkeley Springs, W. Va.	2.00@	2.25
Buffalo, N. Y.	2.00@	2.50
Cedarville and S. Vineland, N. J.—Damp		1.75
Dry		2.25
Elco, Ill.	*18.00@	*31.00
Estill Springs and Sewanee, Tenn.		1.50
Gray Summit and Klondike, Mo.	1.75@	2.00
Los Angeles, Calif.—Washed		5.00
Mapleton Depot, Penn.	2.00@	2.25
Massillon, Ohio		3.00
Mendota, Va.	2.25@	2.50
Michigan City, Ind.		.35
Mineral Ridge and Ohlton, Ohio		2.50
Oceanside, Calif.		3.00
Pittsburgh, Penn.	3.00@	4.00
Ridgway, Penn.		2.50
Rockwood, Mich.	2.75@	3.25
Round Top, Md.		2.00
San Francisco, Calif.	4.00@	5.00
Silica, Va.		2.50
St. Louis, Mo.		2.00
Sewanee, Tenn.		1.50
Thayers, Penn.		2.50
Utica and Ottawa, Ill.	.90@	1.15
Warwick, Ohio (green)		1.75
Zanesville, Ohio		2.50

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Beach City, Ohio		1.75
Columbus, Ohio		.15@ .30
Dresden, Ohio		1.25
Eau Claire, Wis.	3.25	1.00
Estill Springs and Sewanee, Tenn.	1.35@ 1.50	1.35@ 1.50

: *Ground silica, carload.

(Continued on next page)

Wholesale Prices of Sand and Gravel

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in and less
EASTERN:						
Ambridge & So. H'g'ts, Penn.	1.25	1.25	1.15	.85	.85	.85
Attica and Franklinville, N. Y.	.75	.75	.75	.75	.75	.75
Boston, Mass.‡	1.40	1.40	2.25		2.25	2.25
Buffalo, N. Y.	1.10	.95	.95			
Erie, Pa.		1.00*		1.50*	1.75*	
Farmingdale, N. J.	.58	.48	.85	1.25	1.15	
Hartford, Conn.	.05*					
Leeds Junction, Me.		.50	1.75		1.25	1.00c
Machias Jct., N. Y.	.75	.75	.85	.75	.75	.75
Montoursville, Penn.	1.00	.85	1.00	.90	.90	.90
Portland, Me.		1.00	2.25		2.00	
Shining Point, Penn.			1.00	1.00	1.00	1.00
Somerset, Penn.		2.00				
South Heights, Penn.	1.25	1.25	.85	.85	.85	.85
Washington, D. C.	.60@ .85	.60@ .85	1.70	1.50	1.30	1.30
York, Penn.	1.10	1.00				
CENTRAL:						
Aurora, Ill.		.40@ .50	.40	.50	.70	.70
Algonquin and Beloit, Wis.	.50	.40	.60	.60	.60	.60
Appleton and Mankato, Minn.		.45	1.25	1.25	1.25	1.25
Attica, Ind.			All sizes	.75@.85		
Barton, Wis.		.50	.75	.75	.75	.75
Chicago district, Ill.	.70	.55	.55	.60	.60	.60
Columbus, Ohio		.75	.75	.75	.75	
Des Moines, Iowa	.40	.40	1.40	1.40	1.40	1.40
Eau Claire and Chippewa Falls, Wis.	.40	.40	.80	.90	.90	
Elkhart Lake, Wis.	.50	.40	.30	.55	.50	.50
Ferrysburg, Mich.		.50@ .80	.60@1.00	.60@1.00		.50@1.25
Ft. Dodge, Iowa	.85	.85	2.05	2.05	2.05	2.05
Grand Haven, Mich.		.60@ .80	.70@ .90	.70@ .90		.70@ .90
Grand Rapids, Mich.		.50		.80	.80	.70
Hamilton, Ohio		1.50			1.50	
Hersey, Mich.		.50				.70
Humboldt, Iowa	.50	.50	1.50	1.50	1.50	1.50
Indianapolis, Ind.	.60	.60		.90	.75@1.00	.75@1.00
Joliet, Plainfield and Hammond, Ill.	.60	.50	.50	.60	.60	.60
Mason City, Ia.	.50@ .60	.50@ .60	1.30	1.30	1.20	1.20
Mankato, Minn.		.45	1.25	1.25	1.25	1.25
Mattoon, Ill.	.75@ .85	.60@ .85	.85	.85	.85	.85
Milwaukee, Wis.	.96	.91	1.06	1.06	1.06	1.06
Moline, Ill.	.60@ .85	.60@ .85	1.00@1.20	1.00@1.20	1.00@1.20	1.00@1.20
Northern New Jersey	.50	.50		1.25	1.25	
Pittsburgh, Penn.	1.25	1.25	.85	.85	.85	.85
Silverwood, Ind.	.75	.75	.75	.75	.75	.75
St. Louis, Mo.	1.20	1.45	1.55a	1.45	1.45	1.45
Terre Haute, Ind.	.75	.60	.75	.75	.75	.75
Wolcottville, Ind.	.75	.75	.75	.75	.75	.75
Waukesha, Wis.		.45	.60	.60	.65	.65
Winona, Minn.	.40	.40	1.25	1.15	1.15	1.15
Zanesville, Ohio		.60	.50	.60	.80	
SOUTHERN:						
Charleston, W. Va. (b)		All sand, 1.40.	All gravel, 1.40			
Brewster, Fla.	.50@ .60	.50@ .60	2.25			
Chattahoochee River, Fla.		.70		1.75		
Eustis, Fla.		.50@ .60				
Ft. Worth, Texas	2.00	2.00	2.00	2.00	2.00	2.00
Knoxville, Tenn.	1.00	1.20	1.30	1.20	1.20	1.20
Lindsay, Texas					.55	
Macon, Ga.	.50					
New Martinsville, W. Va.	1.00	.90@1.00		1.20@1.30		.80@ .90
Roseland, La.	35	.35	1.25	1.00	.80	.80
WESTERN:						
Kansas City, Mo.		.70				
Los Angeles, Calif. (d)	.50	.50	1.10	1.10		1.10c
Oregon City, Ore.		1.50*	1.50*	1.50*	1.50*	1.50*
Phoenix, Ariz.	1.25	1.10	2.50	2.00	1.25	1.10
Pueblo, Colo.	.80	.60		1.20		1.15
San Diego, Calif.		.75	1.40	1.20	1.00	1.00
Seattle, Wash. (bunkers)	1.25	1.25	1.25	1.25	1.25	1.25

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
Algonquin and Beloit, Wis.			Dust to 3 in., .40			
Burnside, Conn.	.75					
Chicago district, Ill.	.35					
Ferrysburg, Mich.						.65@1.00
East Hartford, Ohio	.75*					
Gainesville, Texas		1.00			.55	
Grand Rapids, Mich.				.50		
Hamilton, Ohio					1.00	
Hersey, Mich.				.50		
Indianapolis, Ind.		Mixed gravel for concrete work, at .65				
Joliet, Plainfield and Hammond, Ill.	.35	1.25				
Macon, Ga.	.35@ .50				.90	
Mankato, Minn.	.30					
Moline, Ill. (b)	.60	.60	Concrete gravel, 50% G., 50% S., 1.00			
Ottawa, Oregon, Moronts and Yorkville, Ill.		Ave. .60 per ton all sizes				
Roseland, La.			.35			
Somerset, Penn.		1.85@2.00		1.50@1.75		
St. Louis, Mo.		Mine run gravel, 1.55 per ton				
Summit Grove, Ind.	.50	.50	.50	.50	.50	.54
Winona, Minn.	.40	.40				
York, Penn.	1.10	1.06				

*Cubic yd. ‡Delivered on job by truck. (a) ⅝ in. down. (b) River run. (c) 2½ in. and less. (d) Less 10c per ton if paid E.O.M. 10 days. (g) ¾-in. and less.

Core and Foundry Sands

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

City or shipping point	Molding, fine	Molding, coarse	Molding, brass	Core	Furnace lining	Sand blast	Stone sawing
Aetna, Ill.				.30@ .35			
Albany, N. Y.	2.00@2.25	2.00	2.00	1.50@2.25	1.50@2.00	1.75@4.50	
Arenzville, Ill.	1.50@1.75			1.00			
Beach City, Ohio	1.75@2.00	1.75@2.00		1.75	2.00		
Buffalo, N. Y.	1.50	1.50		2.00@2.50			
Columbus, Ohio	1.50@2.00	1.25@1.50	2.00	.30	1.75@2.00	2.75@4.50	
Dresden, Ohio	1.50@1.75	1.50	1.75	1.25			
Eau Claire & Chippewa Falls, Wis.						3.00	
Elco, Ill.	Ground silica per ton in carloads—18.00@31.00						
Estill Springs and Sewanee, Tenn.	1.25			1.25		1.35@1.50	
Franklin, Pa.	1.75	1.75		1.75			
Klondike, Mo.	1.75@2.00		1.75@2.00	1.75@2.00	1.75@2.00		1.75
Mapleton Depot, Pa.	2.00	1.90	2.00	2.00		2.00	
Massillon, Ohio	2.50	2.50		2.50	2.50		
Mendota, Va.	Ground flint or silex—16.00@20.00 per ton						
Michigan City, Ind.				.30	.30		
Millville, N. J.				1.75b		3.50	
Montoursville, Pa.				1.35@1.50			
New Lexington, O.	2.00	1.25					
Ohlton, Ohio	2.00*	2.00*		2.00*	2.00*	2.50*	2.00*
Ridgway, Pa.	1.50	1.50	1.50@1.75		1.50d		
Round Top, Md.				1.60		2.25	
San Francisco and Oakland, Calif.	3.50	5.00	3.50	3.50@5.00e	3.50@5.00	3.50@5.00	
Silica, Va.	Potters' flint per ton, 9.00@10.00						
Thayers, Penn.	1.25	1.25		2.00			
Utica, Ill.	.50	.60		.60	.70		
Utica, Penn.	1.75	1.75		2.00			
Warwick, Ohio	*1.75@2.25	*1.75@2.25	2.00	*1.75@2.25	*1.75		
Zanesville, Ohio	2.00‡	1.50‡	2.00‡	2.00	2.00		

*Green. †Crude silica, crushed and screened, not washed or dried. ‡Plus 75c per ton for winter loading. ¶Crude. §Crude and dry. (a) Delivered. (b) Damp. (c) Shipped from Albany. (d) Delivered Buffalo or Black Rock. (e) Washed and drained only, 1.50. (f) Dried, screened.

Crushed Slag

City or shipping point	Roofing	¼ in. down	½ in. and less	¾ in. and less	1½ in and less	2½ in. and less	3 in. and larger
EASTERN:							
Buffalo, N. Y., Emporium, Erie and Dubois, Pa.	2.25	1.25	1.25	1.25	1.25	1.25	1.25
Eastern Penn.	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Northern N. J.	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Reading, Penn.	2.50	1.00		1.25			
Western Penn.	2.50	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Ironton, Ohio		1.30*	1.80*	1.45*		1.45*	
Jackson, Ohio		1.05*		1.30*	1.05*	1.30*	1.30*
Toledo, Ohio	1.50	1.25	1.25	1.25	1.25	1.25	1.25
Youngst'n, O., dist.	2.00	1.25	1.35	1.35	1.25	1.25	1.25
SOUTHERN:							
Ashland, Ky.		1.55*		1.55*	1.55*	1.55*	1.55*
Ensley and Alabama City, Ala.	2.05	.80	1.35	1.25	.90	.90	.80
Longdale, Roanoke, Ruessens, Va.	2.50	1.00	1.25	1.25	1.25	1.15	1.15
Woodward, Ala.	2.05*	.80*	1.35*	1.25*	.90*	.90*	

*5c per ton discount on terms.

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Blk.	Ground burnt lime, Bags	Lump lime, Blk.	Lump lime, Bbl.
EASTERN:								
Berkeley, R. I.			12.00					2.15e
Buffalo, N. Y.		12.00	12.00	12.00			10.00	1.95d
Chazy, N. Y.		8.50	7.50	10.00		15.50₉	8.50	14.00
Lime Ridge, Penn.							5.00a	
West Stockbridge, Mass.	12.00	10.00	5.60					2.00t
Williamsport, Penn.			10.00				6.00	
York, Penn.		9.50	9.50	10.50	8.50	10.50	8.50	1.65i
CENTRAL:								
Afton, Mich.							8.50	1.35
Carey, Ohio	12.50	8.50	8.50		9.00		8.00	
Cold Springs, Ohio		8.50	8.50				8.00	
Cold Springs and Gibsonburg, Ohio	12.50	8.50	8.50		9.00	11.00		
Frederick, Md.		10.00	10.00	10.00	8.50	10.00	7.00	
Huntington, Ind.	12.50	8.50	8.50		9.00		8.00	
Luckey, Ohio	12.50							
Marblehead, Ohio		8.50	8.50		9.00		8.00	1.50w
Milltown, Ind.		8.50@10.00		10.00p			8.50₈	1.35r
Scioto, Ohio	12.50₁₀	8.50	8.50	10.00	.62½	7.50	1.50c	1.70d
Sheboygan, Wis.	11.50				9.50		9.50	.95
Wisconsin points (f)		11.50					9.50	
Woodville, Ohio	12.50	8.50	8.50	13.50	9.00		9.00	1.50c
SOUTHERN:								
Allgood, Ala.	12.50	10.00			8.50		8.50	1.50
El Paso, Texas							7.00	
Graystone & Landmark, Ala.	12.50		9.00	9.00			8.50	1.35
Keystone, Ala.	12.50	9.00	9.00	9.00			8.00	1.35
Knoxville, Tenn.	20.25	9.00	9.00	8.00	1.25e	8.00	1.35	
New Braunfels, Tex.	18.00	12.00	10.00	12.00	10.00		9.50	
Ocala, Fla.		11.00	9.00				11.00	1.50
Saginaw, Ala.	12.50	10.00	9.00	10.00			8.50	1.50
WESTERN:								
Kirtland, N. M.							15.00	
Limestone, Wash.	15.00	15.00	10.00	15.00	16.50	16.50	16.50	2.09
Los Angeles, Calif.	19.00	19.00	14.00		16.20		12.50	2.50
Dittlinger, Tex.		12.00@13.00					9.50p	1.50₄
San Francisco, Calif.	21.00	19.00	16.50				14.00	2.00
Tehachapi, Calif.			8.00				13.00z	2.20x
Seattle, Wash.	19.00	19.00	12.00	19.00	19.00		18.60	2.30

†50-lb. paper bags; (a) net ton; (c) wooden, steel 1.70; (d) steel; (e) per 180-lb. barrel; (f) dealers' prices, net 30 days less 25c disc. per ton on hydrated lime and 5c per bbl. on lump if paid in 10 days; (i) 180-lb. net barrel, 1.65; 280-lb. net barrel, 2.65; (p) to 11.00; (q) to 8.75; (r) to 1.50; (s) in 80-lb. burlap sacks; (t) to 3.00; (u) two 90-lb. bags; (v) oil burnt; wood burnt 2.25@2.50; (x) wood. steel 2.30; (z) to 15.00; (*) quoted f.o.b. New York; (‡) paper bags; (w) to 1.50 in two 90-lb. bags, wood bbl. 1.60; (¶) to 10.00; (₁) 80-lb. paper bags; (₂) to 3.00; (₃) to 9.00; (₄) to 1.60. (₅) to 16.00; (₆) wood bbl., steel, 1.80; (₇) quoted f.o.b. Marble Cliff, Ohio; (₈) superfine; (₉) barrels. (₁₀) f.o.b. Woodville.

Miscellaneous Sands

(Continued)

City or shipping point	Roofing sand	Traction
Mapleton Depot, Penn.	1.50	2.00@ 2.25
Massillon, Ohio		2.25
Michigan City, Ind. (Engine sand)		.20@ .30
Mineral Ridge, Ohio	*1.75	*1.75
Montoursville, Penn.		1.00@ 1.10
Ohlton, Ohio	a2.00	a1.75
Red Wing, Minn.		1.25
Round Top, Md.	2.25	1.75
San Francisco, Calif.	3.50	3.50
Thayers, Penn.		2.25
Utica & Ottawa, Ill.	b.90@ 3.50	.90
Warwick, Ohio		2.25
Zanesville, Ohio		2.50

*Wet. †Fine; coarse dry, 3.00@3.50.
(a) Green. (b) Dried, screened.

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point.

Baltimore, Md.:	
Crude talc (mine run)	3.00@ 4.00
Ground talc (20-50 mesh), bags	10.00
Cubes	55.00
Blanks (per lb.)	.08
Pencils and steel worker's crayons	.08
per gross	1.00@ 1.50
Chatsworth, Ga.:	
Crude talc, grinding	5.00
Ground talc (150-200 mesh) bags	10.00
Pencils and steel worker's crayons, per gross	1.00@ 2.50
Chester, Vt.:	
Ground talc (150-200 mesh), bulk	8.00@ 9.00
Including bags	9.00@10.00
Chicago and Joliet, Ill.:	
Ground (150-200 mesh), bags	30.00
Dalton, Ga.:	
Crude talc	5.00
Ground talc (150-200) bags	10.00@12.00
Pencils and steel workers' crayons, per gross	1.00@ 1.50
Emeryville, N. Y.:	
(Double air floated) including bags; 325 mesh	14.75
200 mesh	13.75
Hailesboro, N. Y.:	
Ground white talc (double and triple air floated) including bags, 300-350 mesh	15.50@20.00
Henry, Va.:	
Crude (mine run)	3.50@ 4.00
Ground talc (150-200 mesh), bulk	8.50@16.00
Joliet, Ill.:	
Roofing talc, bags	12.00
Ground talc (200 mesh), bags	32.00
Keeler, Calif.:	
Ground (200-300 mesh), bags	20.00@30.00
Natural Bridge, N. Y.:	
Ground talc (125-200 mesh), bags	10.00@15.00

Rock Phosphate

Prices given are per ton (2240-lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

Gordonsburg, Tenn.—B.P.L. 65-72%	3.75@ 4.50
Mt. Pleasant, Tenn.—B.P.L. 75%	5.50@ 6.00
Tennessee—F.O.B. mines, gross ton, unground brown rock, B.P.L. 72%	5.00
B.P.L. 75%	6.00
Twomey, Tenn.—B.P.L. 65%, 2000 lb.	8.00@ 9.00

Ground Rock

(2000 lbs.)

Centerville, Tenn.—B.P.L. 65%	8.00
Gordonsburg, Tenn.—B.P.L. 65-70%	4.00@ 4.50
Mt. Pleasant, Tenn.—B.P.L. 72%	9.50
Twomey, Tenn.—B.P.L. 65%	8.00@ 9.00

Florida Phosphate

(Raw Land Pebble)

(Per Ton.)

Florida—F. O. B. mines, gross ton, 68/66% B.P.L., Basis 68%	3.25
70% min. B.P.L., Basis 70%	3.75

Mica

Prices given are net, F.O.B. plant or nearest shipping point.

Pringle, S. D.—Mine run, per ton	125.00
Punch mica, per lb.	.06
Scrap, per ton, carloads	20.00
Rumney Depot, N. H.—per ton,	
Mine run	360.00
Clean shop scrap	25.00
Mine scrap	22.00
Roofing mica	30.00
Punch mica, per lb.	.12

Cut Mica—50% from Standard List.

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Barton, Wis., f.o.b. cars	....	10.50
Brandon, Vt.—English pink, English cream and coral pink	*11.00	*11.00
Brandon grey	*11.00	*11.00
Brighton, Tenn.—Pink	6.00	5.00
Mixed pink and bronze	4.50@ 6.00	4.50@ 6.00
All colors, mixed sizes	3.50	3.50
Buckingham, Que.—Buff stucco dash	....	12.00@14.00
Chicago, Ill. — Stucco chips, in sacks f.o.b. quarries	....	17.50
Crown Point, N. Y.—Mica spar	....	9.00@10.00
Dayton, Ohio	....	6.00@24.00
Easton, Penn., and Phillipsburg, N. J.	....	12.00@16.00
Haddam, Conn. — Felstone buff	15.00	15.00
Harrisonburg, Va.—Bulk marble (crushed, in bags)	†12.50	†12.50
Ingomar, Ohio — Concrete facings and stucco dash	....	32.00
Middlebrook, Mo.—Red	....	20.00@25.00
Middlebury, Vt.—Middlebury white	‡9.00	‡9.00
Middlebury and Brandon, Vt.—Caststone, per ton, including bags	....	5.50
Milwaukee, Wis.	....	14.00@34.00
Newark, N. J.—Roofing granules	....	7.50
New York, N. Y.—Red and yellow Verona	....	32.00
Red Granite, Wis.	....	7.50
Stockton, Calif. — "Natrock" roofing grits		12.00@20.00
Tuckahoe, N. Y.—Tuckahoe white	12.00	....
Wauwatosa, Wis.	....	20.00@25.00
Wellsville, Colo.—Colorado Travertine Stone	15.00	15.00

†C.L. L.C.L. 17.00.
*C.L. including bags; L.C.L. 14.50
‡C.L. including bags, L.C.L. 10.00.

Potash Feldspar

Auburn and Brunswick, Me.—Color, white; 98% thru 140 mesh bulk	19.00
Bristol, Tenn.—Color, white; analysis, K_2O, 6 to 10%; Na_2O, 2½ to 4%; SiO_2, 68 to 78%; Fe_2O_3, 12 to 20%; Al_2O_3, 16.5 to 18.5%; 99% thru 200 mesh; bulk, depending on grade	14.50@18.00
Buckingham, Que.—Color, white; analysis, K_2O, 12-13%; Na_2O, 1.75%; bulk	9.00
De Kalb Jct., N. Y.—Color, white; bulk (crude)	9.00
East Hartford, Conn.—Color, white, 95% through 60 mesh, bags	16.00
96% thru 150 mesh, bags	28.00
East Liverpool, Ohio—Color, white; 98% thru 200 mesh, bulk	19.35
Soda feldspar, crude, bulk, per ton	22.00
Glen Tay Station, Ont., color, red or pink; analysis: K_2O, 12.81%, crude (bulk)	7.00
Keystone, S. D.—Prime white, bulk (crude)	8.00
Los Angeles, Calif. — Color, white; analysis, K_2O, 12.16; Na_2O, 1.53; SiO_2, 65.60; Fe_2O_3, .10; Al_2O_3, 10.20; crude	10.05
Pulverized, 95% thru 200 mesh; bags, 22.00; bulk	20.00
Murphysboro, Ill.—Color, prime white; analysis, K_2O, 12.60%; Na_2O, 2.35%; SiO_2, 63%; Fe_2O_3, .06%; Al_2O_3, 18.20%; 98% thru 200 mesh; bags, 21.00; bulk	20.00
Penland, N. C.—Color, white; crude, bulk	8.00
Ground, bulk	16.50
Tenn. Mills—Color, white; analysis K_2O, 18%; Na_2O, 10%; 68% SiO_2; 99% thru 200 mesh; bulk	18.00
99% thru 140 mesh, bulk	16.00
Topsham, Me.—98% thru 140 mesh, bulk	19.00
Toronto, Can.—Color, flesh; analysis K_2O, 12.75%; Na_2O, 1.96%; crude	7.50@ 8.00

Chicken Grits

Afton Mich. (limestone) per ton	10.00
Belfast and Rockland, Me.—(Limestone), bags, per ton	‡10.00
Brandon and Middlebury, Vt., per ton	10.00
Cartersville, Ga.—(Limestone), per bag	2.00
Centerville, Iowa (gypsum) per ton	18.00
Chico, Texas (limestone), 100 lb. bags, per ton	8.00@ 9.00
Danbury, Conn. (limestone), bulk	6.00@ 7.00
Easton, Penn.—Per ton, bulk	3.00
Joliet, Ill.—(Limestone), bags, per ton	4.50
Knoxville, Tenn.—per bag	1.25
Los Angeles, Calif. (feldspar) per ton	15.00
Gypsum, Ohio.—(Gypsum) per ton	10.00
Limestone, Wash. (limestone) per ton	12.50
Marion, Va.—(Limestone), bulk, 5.00; bagged, 6.50; 100-lb. bag	.50
Rocky Point, Va. (limestone) 100 lb. bags, 50c; sacks, per ton, 6.00 bulk	5.00
Seattle, Wash.—(Limestone), bulk, per ton	10.00
Warren, N. H.—(Mica) per ton	3.85@ 3.90
Waukesha, Wis.—(Limestone), per ton	8.00
West Stockbridge, Mass.—(Limestone) bulk	‡7.50@*9.00
Wisconsin Points (limestone) per ton	9.00

*L.C.L. †Less than 5-ton lots. ‡C.L.

Sand-Lime Brick

Prices given per 1000 brick f.o.b. plant or nearest shipping point, unless otherwise noted.

Albany, N. Y.	10.00
Anaheim, Calif.	10.50@11.00
Barton, Wis.	10.50@13.00b
Boston, Mass.	*17.00
Brighton, N. Y.	*19.75
Brownstone, Penn.	11.00
Dayton, Ohio	12.50@13.50
Detroit, Mich.	17.50
Farmington, Conn	13.00
Flint, Mich.	¶12.00@17.50*
Grand Rapids, Mich.	12.50
Hartford, Conn.	*18.50
Jackson, Mich.	12.25
Lakeland, Fla.	10.00@11.00
Lake Helen, Fla.	9.00@15.00
Lancaster, N. Y.	12.50
Madison, Wis.	a12.50
Michigan City, Ind.	11.00
Milwaukee, Wis.	*13.00
Minneapolis and St. Paul, Minn.	10.00
Minnesota Transfer	10.00
New Brighton, Minn.	10.00
Pontiac, Mich.	14.50
Portage, Wis.	16.00
Prairie du Chien, Wis.	18.00@22.50
Rochester, N. Y.	*19.75
Saginaw, Mich.	13.00
San Antonio, Texas	16.00
Sebewaing, Mich.	12.00
Sioux Falls, S. Dak.	13.00c
South River, N. J.	14.00
Syracuse, N. Y.	18.00@20.00*
Toronto, Canada	13.50
Wilkinson, Fla.	10.00@12.00
Winnipeg, Canada	14.00

*Delivered on job. †Delivered in city. ‡Less 5%. ¶Dealers' price. (a) Less .50 E.O.M. 10 days. (b) Delivered to Milwaukee. (c) Delivered at yard.

Portland Cement

Prices per bag and per bbl, without bags net in carload lots.

	Per Bag	Per Bbl.
Albuquerque, N. M.	.86¾	3.47
Atlanta, Ga.	——	2.35
Baltimore, Md.	....	2.15
Birmingham, Ala.	....	2.30
Boston, Mass.	....	2.13
Buffalo, N. Y.	....	2.20
Butte, Mont.	.90¼	3.61
Cedar Rapids, Iowa	....	2.24
Charleston, S. C.	....	2.35
Cheyenne, Wyo.	.82¾	3.31
Cincinnati, Ohio	.58	2.32
Cleveland, Ohio	....	2.24
Chicago, Ill.	.51¼	2.05
Columbus, Ohio	.57¼	2.29
Concrete, Wash.	....	2.35
Dallas, Texas	....	2.00
Davenport, Iowa	....	2.24
Dayton, Ohio	.58¼	2.33
Denver, Colo.	.06¼	2.65
Des Moines, Iowa	....	2.05
Detroit, Mich.	....	2.15
Duluth, Minn.	....	2.04
Houston, Texas	....	2.00
Indianapolis, Ind.	.54¾	2.19
Jackson, Miss.	....	2.50
Jacksonville, Fla.	....	2.20
Jersey City, N. J.	....	2.03
Kansas City, Mo.	....	1.92
Los Angeles, Calif.	.59½	2.38
Louisville, Ky.	.55½	2.22
Memphis, Tenn.	....	2.50
Milwaukee, Wis.	....	2.20
Minneapolis, Minn.	....	2.12
Montreal, Que.	....	1.36
New Orleans, La.	....	2.20
New York, N. Y.	....	1.93
Norfolk, Va.	....	2.07
Oklahoma City, Okla.	....	2.46
Omaha, Neb.	....	2.36
Peoria, Ill.	....	2.22
Philadelphia, Penn.	....	2.21
Phoenix, Ariz.	.81½	3.26
Pittsburgh, Penn.	....	2.04
Portland, Colo.	....	2.80
Portland, Ore.	....	2.60
Reno, Nev.	....	2.91
Richmond, Va.	....	2.24
Salt Lake, Utah	.70¼	2.81
San Francisco, Calif.	....	2.21
Savannah, Ga.	....	2.50
St. Louis, Mo.	.51¼	2.05
St. Paul, Minn.	....	2.12
Seattle, Wash.	....	2.50*
Tampa, Fla.	....	2.25
Toledo, Ohio	....	2.20
Topeka, Kans.	....	2.41
Tulsa, Okla.	....	2.33
Wheeling, W. Va.	....	2.12
Winston-Salem, N. C.	....	2.62

NOTE—Add 40c per bbl. for bags.
†Delivered on job in any quantity, sacks extra.
‡Less 5c bbl. 10 days.
*Ten cents discount for cash, 10 days. (a) Price includes sacks.

Mill prices f.o.b. in carload lots, without bags, to contractors.

	Per Bag	Per Bbl
Buffington, Ind.	....	1.80
Chattanooga, Tenn.	....	2.45*
Concrete, Wash.	....	2.35
Davenport, Calif.	....	2.45
Detroit, Mich.	....	2.15
Hannibal, Mo.	....	1.90
Hudson, N. Y.	....	1.75
Leeds, Ala.	....	1.85
Mildred, Kans.	....	2.35
Nazareth, Penn.	....	1.95
Northampton, Penn.	....	1.75
Richard City, Tenn.	....	2.05
Steelton, Minn.	....	1.85
Toledo, Ohio	....	2.20
Universal, Penn.	....	1.80

*Including sacks at 10c each.

Gypsum Products—CARLOAD PRICES PER TON AND PER M SQUARE FEET, F. O. B. MILL

	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco Calcined Gypsum	Cement and Gauging Plaster	Wood Fiber	White Gauging	Sanded Plaster	Keene's Cement	Trowel Finish	—Plaster Board— ¼x32x 36". Wt. 1500 lb. Per M Sq. Ft.	⅜x32x 36". Wt. 1850 lb. Per M Sq. Ft.	Wallboard, ⅜x32 or 48". Lgths. 6'-10', 1850 lb. Per M Sq. Ft.
Arden, Nev. and Los Angeles, Calif.	3.00	8.00u	8.00u	10.70u	10.70u	....	....	....	....	11.70u	....	....	
Centerville, Iowa	3.00	10.00	15.00	10.00	10.00	10.50	13.50		....	13.50	....	....	
Des Moines, Ia.	3.00	8.00	9.00	10.00	10.00	10.50	13.50	12.00	24.00	22.00	18.00	21.00	30.00
Detroit, Mich.	....	....	....	....	14.30o	12.30m	....	m9.00@11.00o	....	....		....	....
Delawanna, N. J.	——	——	——	——	——	8.00	....	8.25@9.40	....	....	.14⅕s	.15⅕s	40.00@41.00
Douglas, Ariz.	....	....	6.00	....	....	....	15.00	....	40.00	13.50	35.00	45.00	....
Grand Rapids, Mich.	2.75	6.00	6.00	8.00	9.00	9.00	17.50	....	24.55	20.00	....	....	....
Gypsum, Ohio	3.00	4.00	6.00	8.00	9.00	9.00	20.00	7.00	27.00	19.00	....	15.00	30.00
Los Angeles, Calif.	....	....	7.50@9.50	11.50y	....	....	....	....	....	....	....	....	....
Port Clinton, Ohio	3.00	4.00	6.00	10.00	9.00	9.00	21.00	7.00	30.15	20.00	....	20.00	30.00
Portland, Colo.	....	....	....	10.00	....	....	....	....	....	....	....	....	....
San Francisco, Calif.	....	....	11.65m	13.40r	14.40r	....	15.40r	....	....	....	....	....	....
Seattle, Wash.	6.40	11.00	11.00	13.00	....	....	....	....	28.00	....	....	....	....
Sigurd, Utah	....	....	....	....	....	....	....	....	21.50	....	....	....	....
Winnipeg, Man.	5.00	5.00	7.00	13.00	14.00	14.00	....	....	....	....	20.00	25.00	33.00

NOTE—Returnable bags, 10c each; paper bags, 1.00 per ton extra (not returnable).
*To 3.00; †to 11.00; ‖to 12.00; ‡prices per net ton, sacks extra; (a) to 25.00; (b) net; (c) gross; (d) hair fibre; (?) delivered; (h) delivered in six states; (i) delivered on job; (k) sacks 12c extra, rebated; (m) includes paper bags; (o) includes jute sacks; (r) including sacks at 15c; (s) per board; (t) to 16.50; (u) includes sacks; (v) F.O.B. N. Y. C. and dealer's yard in mill locality; (x) Hardwall plaster; (y) sacks 15c extra, rebated.

Market Prices of Cement Products

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point

City of shipping point	8x8x16 (Sizes)	8x10x16 (Sizes)	8x12x16 (Sizes)
Camden, N. J.	17.00	......	......
Cement City, Mich.		5x8x12—55.00¶	
Columbus, Ohio	.16@.18a	......	......
Detroit, Mich.	.16	......	.18
Forest Park, Ill	18.00*	23.00*	30.00*
Grand Rapids, Mich.	15.00@16.00a	......	......
Graettinger, Iowa	.18@.20	......	......
Indianapolis, Ind.	.13@.15†	......	......
Los Angeles, Calif.¶	5¾x3½x12—55.00	7¾x3½x12—65.00	
Oak Park, Ill.	18.00	......	......
Olivia and Mankato, Minn.	9.50b	......	......
Somerset, Penn.	.20@.25	......	......
Tiskilwa, Ill.	.16@.18†	......	......
Yakima, Wash.	20.00*	......	......

*Price per 100 at plant. †Rock or panel face. (a) Face. ‡Delivered. ¶Price per 1000. (b) Per ton.

Cement Roofing Tile

Prices are net per sq. in carload lots, f.o.b. nearest shipping point unless otherwise stated.

Camden and Trenton, N. J.—8x12, per sq.

Red	15.00
Green	18.00
Chicago, Ill.—per sq.	20.00

Cicero, Ill.—Hawthorne roofing tile, per sq.

	Chocolate, Red, Yellow, Gray and Orange	Green, Blue
French and Spanish†	$11.50	$13.50
Ridges (each)	.25	.35
Hips	.25	.35
Hip starters	.50	.60
Hip terminals, 2-way	1.25	1.50
Hip terminals, 4-way	4.00	5.00
Mansard terminals	2.50	3.00
Gable finials	1.25	1.50
Gable starters	.25	.35
Gable finishers	.25	.35
*End bands	.25	.35
*Eave closers	.06	.08
*Ridge closers	.05	.06

*Used only with Spanish tile.
†Price per square.

Houston, Texas.—Roofing Tile, per sq.	25.00
Indianapolis, Ind.—9x15-in.	Per sq.
Gray	10.00
Red	11.00
Green	13.00
Waco, Texas:	Per sq.
4x4	.60

Cement Building Tile

Grand Rapids, Mich.	Per 100
5x8x12	8.00
5x4x12	4.50
5x8x12	8.00
Longview, Wash.	Per 1000
4x6x12	52.00
4x8x12	64.00
Mt. Pleasant, N. Y.:	**Per 1000**
5x8x12	**78.00**
Grand Rapids, Mich.:	**Per 100**
5x8x12	7.00
Houston, Texas:	
5x8x12 (Lightweight)	**80.00**
Pasadena, Calif. (Stone-Tile)	Per 100
3½x4x12	3.00
3½x6x12	4.00
3½x8x12	5.50
Tiskilwa, Ill.—8x8, per 100	15.00
Wildasin Spur, Los Angeles, Calif. (Stone-Tile)	Per 1000
3½x6x12	50.00
3½x8x12	60.00
Prairie du Chien, Wis.:	
5x8x12	82.00
5x4x12	46.00
5x8x 6 (half-tile)	41.00
5x8x10 (fractional)	82.00
Yakima, Wash.—Building tile:	
5x8x12	.10

Cement Drain Tile

Graettinger, Iowa—5 to 36 in., per ton	8.00
Olivia and Mankato, Minn.—Cement drain tile, per ton	8.00
Tacoma, Wash.—Drain tile per ft.:	
3 in.	.04
4 in.	.05
6 in.	.07½
8 in.	.10
Waukesha, Wis.—Drain tile, per ton	8.00

Concrete Brick

Prices given per 1000 brick, f.o.b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	22.00	25.00@40.00
Baltimore, Md. (Del. according to quantity)	15.50	22.00@50.00
Camden and Trenton, N. J.	17.00	
Ensley, Ala. ("Slagtex")	14.50	22.50@33.50
Eugene, Ore.	25.00	35.00@75.00
Friesland, Wis.	22.00	32.00
Longview, Wash.	18.00	25.00@75.00
Milwaukee, Wis.	15.00	28.00@50.00
Mt. Pleasant, N. Y.	......	14.00@23.00
Oak Park, Ill.	25.00	a42.00
Omaha, Neb.	18.00	30.00@40.00
Pasadena, Calif.	10.00	......
Philadelphia, Penn.	14.75	20.00
Portland, Ore.	17.50	25.00@75.00
Mantel brick—100.00@150.00		
Prairie du Chien, Wis.	14.00	22.50@25.00
Rapid City, S. D.	18.00	25.00@80.00
Waco, Texas	16.50	32.50@125.00
Watertown, N. Y.	20.00	35.00
Westmoreland Wharves, Penn.	14.75	20.00
Winnipeg, Man.	14.00	22.00
Yakima, Wash.	22.50	......

†Gray. ‡Red. (a) Haydenite H. Brick.

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise noted.

Culvert and Sewer	4 in.	6 in.	8 in.	10 in.	12 in.	15 in.	18 in.	20 in.	22 in.	24 in.	27 in.	30 in.	36 in.	42 in.	48 in.	54 in.	60 in.
Detroit, Mich.								15.00 per ton									
Graettinger, Iowa	.04½d	.05½	.08½	.12½	.17½	—	.40	.50	.60	.70	—	—	—	—	—	—	—
G'd Rapids, Mich. (b)																	
Culvert pipe	—	—	—	.60	.72	1.00	1.28	1.60†	—	1.92	2.32	3.00	4.00	5.00	6.00	—	—
Sewer pipe (d)	—	—	—	—	—	.63	—	.60†	—	—	—	.58	—	—	—	—	—
Houston, Texas	—	.19	.28	.43	.55½	.90	1.30	—	†1.70	2.20	—	—	—	—	—	—	—
Indianapolis, Ind. (a)	—	—	—	.80	.90	1.10	1.30	—	—	1.70	—	2.70	—	—	—	—	—
Longview, Wash.							Sewer pipe 40% off list, culvert—list										
Mankato, Minn. (b)	—	—	—	—	—	—	—	—	—	1.50	1.75	2.50	3.25	4.25	—	—	—
Newark, N. J.						6 in. to 24 in., $18.00 per ton											
Norfolk, Neb. (b)	—	—	—	.90	1.00	1.13	1.42	—	—	2.11	—	2.75	3.58	—	6.14	—	7.78
Olivia, Mankato, Minn.							12.00 per ton										
Paullina, Iowa‡	—	—	—	—	—	—	—	2.25	—	2.11	—	2.75	3.58	—	6.14	—	7.78
Somerset, Penn.	—	—	—	—	1.08	1.25	1.65	—	—	2.50	—	3.65	4.85	7.50	8.50	—	—
Tacoma, Wash.	.15	.18	.22½	.30	.40	.55	.75	—	—	—	—	—	—	—	—	—	—
Tiskilwa, Ill. (rein.) (a)	—	—	—	.65	.75	.85	1.10	1.60	—	1.90	—	2.25	3.40	—	5.50	—	—
Wahoo, Neb. (b)	—	—	—	—	1.00	1.13	1.42	—	—	2.11	—	2.75	3.58	4.62	6.14	6.96	7.78
Yakima, Wash.									$10.00 per ton								

30-in. lengths up to 27-in. diam., 48-in. lengths after; (a) 24-in. lengths; (b) Reinforced; (c) Interlocking bar reinforced. (d) Eastern clay, list, 72% and 60% off.
*21-in. diam. ‡Price per 2 ft. length. (d) 5 in. diam. [1]@1.08 [2]@1.25. [3]@1.65. [4]@2.50. [5]@3.85. [6]@5.00. [7]@7.50.

Recent Contract and Bid Prices on Rock Products

Madison County, Iowa. Contracts were let recently for the surfacing of 26 miles of roads. Eighteen bidders were present to bid on the work.

The letting was especially interesting because of the adoption of crushed stone as surfacing material. At least two-thirds of the 26 miles will be surfaced with crushed stone, and it may be used exclusively on Primaries 16 and 24.

Frank Cram and Sons were awarded the contracts on Primaries 16 and 24 for $2.17 and $2.26 per yard.

Orange County, Calif. Rock companies in the country are reported to have raised the prices of various materials about 50%.

The producing companies raised delivered prices on rock from $1.20 a ton to $1.90 a ton, less 10 cents a ton for cash and quotations on sand have been increased from $1 to $1.55, less the cash discount.

Batching has been raised from an average of approximately $1.15 a ton to $1.90 less the discount. The latter price has been fixed as standard. In the past there has been no definite price, the materials being supplied under competitive bidding.

The producing companies maintain that former prices did not give them a fair return either for the material or for cartage and that an increase was necessary if the companies were to survive.

O. V. Barkman of the Orange County Rock Co. declared that even under the new schedule quotations in Orange county are less than anywhere else in the country.

"In the past the companies have been experimenting on the question of volume and prices and have maintained low prices in the belief that volume would result that would justify operation on the lower schedules," Barkman said. "They have found at no little expense that low prices have not been effective in producing volume and that citizens have not availed themselves of the low prices by carrying on extensive improvements in which the materials are used."—*Los Angeles* (Calif.) *Times.*

South Carolina. A despatch in the Philadelphia (Penn.) *Public Ledger* states that the International Cement Corp. has reduced the price of cement 30 cents a barrel in Wilmington and Charleston, S. C.

Empire State Gravel Producers Ask Better Rates

MEMBERS of the Empire State Sand and Gravel Producers Association met at the Rochester, N. Y., Chamber of Commerce on April 12 to further the movement to obtain the co-operation of chambers of commerce in New York state in the effort to obtain newer uniform and equitable freight rates on sand and gravel in the state.

There is ample opportunity for fruitful work by the association, John F. Coyle, assistant manager of the Transportation Bureau of the Rochester Chamber of Commerce, declared, in pointing to the lack of uniformity and the high minimum rate on sand and gravel at various points in the state. Mr. Coyle also touched on the general investigation of the situation being conducted by the Interstate Commerce Commission, and stated that it is expected that within a few months the commission will make a report relative to greater unification of rates and perhaps include recommendations.

Discuss Methods to Further Use of Sand and Gravel

The address by Mr. Coyle was followed by a general discussion of methods of obtaining the greater use of sand and gravel in construction. John G. Carpenter, president and general manager of the Madison Sand and Gravel Corp., Hamilton, N. Y., and secretary and treasurer of the association, reported concerning activities of the association in the last few months. He stressed greater co-operation on the part of individual members of the association with the officers in promoting greater use of sand and gravel and in obtaining specifications to permit its use in a more general way.

Members of the association were guests of the Valley Sand and Gravel Co. and the Consolidated Materials Corp. of Rochester, and were entertained at luncheon by the Chamber of Commerce. In the forenoon a tour of the Consolidated Materials Corp. plant and of the Wadsworth plant of the Valley Sand and Gravel Co. was made, and the visitors were shown about the city.

In pointing out the importance of the sand and gravel industry, Mr. Carpenter stated that coal is the only commodity that furnishes greater volume of traffic to the railroads than the sand and gravel, and that consumption of sand and gravel in the last three years has increased 15% per year. The industry, in spite of that, is regarded as being merely in its infancy, and far greater results are promised for the future.

The next meeting will take place in May at the Madison Sand and Gravel Co. at Hamilton, or with the Buffalo Gravel Corp. at Buffalo, it was announced.

Registration

The following participated in the meeting: G. K. Smith, representing the Albany Gravel Co., and president of the association; D. Hyman, president of the Buffalo Gravel Co. and vice-president of the association; John G. Carpenter, president and general manager of the Madison Sand and Gravel Co. and secretary and treasurer of the association; Weston Carroll, of J. E. Carroll Sand Co., Buffalo; W. J. Weinand, Jr., of East Aurora Sand and Gravel Corp.; Mr. Miller, Clean Sand Co., Boonville, N. Y.; Nathan Oaks, Nathan Oaks & Sons of Oaks Corners; Carlton Oaks, of the same company; D. L. Evans, Rome Cast Stone Co., Inc., Rome; Edward Whaley, Lake Ontario Sand Co.; L. M. Beattie, treasurer, Valley Sand and Gravel Co.; John Taylor, president, Valley Sand and Gravel Co.; Edward G. Stallman, secretary of the same company, and W. J. Gilmores, sales manager; H. L. Marsh and Henry Marsh, Jr., of the Consolidated Materials Corp.; N. S. Snyder, Link-Belt Co., Buffalo; John F. Coyle, assistant manager of the Rochester Chamber of Commerce Transportation Bureau; William A. Burdick, secretary of the Community Board.—*Rochester* (N. Y.) *Democrat and Chronicle.*

Wisconsin Granite to Extend West Point, Wis., Quarry Operations

WISCONSIN GRANITE CO., which operates 14 quarries in Wisconsin and other states, due to the favorable outlook in the granite industry, is reported contemplating extending quarry operations at its West Point quarry near Lohrville with William Wiske as superintendent. The quarry is owned by John J. Wood of Berlin and others and was formerly operated by William Bannerman for about 10 years, his lease expiring about 1914 when the Waushara Granite Co. leased it for about six years. In 1922 the Wisconsin Granite Co. took over the lease and will now put the quarry in full operation for the first time in four years. Since 1922 operations have been confined chiefly to production of grout, large stocks of which have been made during the past winter. Crushed stone, stocked since last November, is being shipped regularly and all orders are expected to be filled.

The company has erected a new office building and a blacksmith shop and has installed a derrick, a compressor and pipe lines removed from its quarry at Berlin.

Portland Cement Association Makes H. R. Albion District Engineer

H. R. ALBION has been appointed district engineer in charge of the Jacksonville, Fla., office of the Portland Cement Association. Before entering the association employ in 1926 as a field representative in Florida, Mr. Albion had wide experience in engineering practice, including five years as senior partner of the engineering firm of Albion and Ewing.

Pacific Coast Coal Company to Build Seattle Cement Mill

A $3,000,000 development program, involving construction of a cement plant near Seattle, purchase of properties in Alaksa and opening of new coal mining operations in the Black Diamond and Carbonada fields, was formally announced recently by Walter Barnum of New York, president of the Pacific Coast Co., Portland, Ore.

Mr. Barnum said his company planned to spend more than $1,000,000 on a cement plant, which would have an annual capacity of 500,000 bbl.

"A few years ago the Pacific Coast Co. retired from the steamship business, in which, in addition to its coal mining activities, it has been engaged in this district for more than half a century," Mr. Barnum said. "Since then the company has been studying the industrial field with a view to engaging in one or more new major activities. For the past year cement manufacture has been having particular attention, and I am now in position to say that the investigation of the project is complete. Our plans contemplate a modern plant, to be expanded as warranted, of 500,000 bbl. initial annual capacity, to be built in the Seattle district. I am not yet in position to announce the location, but the design of the plant is under way, inquiries are out for the machinery and expenditures for final construction surveys have been authorized and this work has already started."

The Pacific Coast Coal Co., Pacific Coast Railroad Co. and the Pacific Coast Engineering Co. are subsidiaries of the Pacific Coast Co.—*Seattle* (Wash.) *Record.*

U. S. Gypsum Company in New Offices at Chicago

NEW offices of the United States Gypsum Co., the third offices occupied in 25 years of business existence, were opened Monday, April 11, with more than 600 employes and executives at their desks. At its present address, 300 West Adams street, Chicago, the company occupies three floors, the area totaling about 62,000 sq. ft. The removal was from 205 West Monroe street, where the offices of the company had been located for 24 years.

An interesting feature of the new offices is that the walls throughout are finished with "Textone," and virtually all the ceilings with "Sabinite" acoustical plaster. This last product was just offered for sale by the United States Gypsum Co. in 1926 under license from Dr. Paul E. Sabine of Riverbank Laboratories. Acoustical efficiency it is said results from the ability of "Sabinite" to change a certain portion of the sound energy that strikes it into heat. In this way the overlapping of reflected sound waves is said to be minimized, and through the application of a formula perfected by Dr. Sabine satisfactory acoustical conditions for any interior before the building is constructed can be obtained, the company says.

Selection and Protection of Motors

Characteristics of Various Types of Motors and Their Special Application

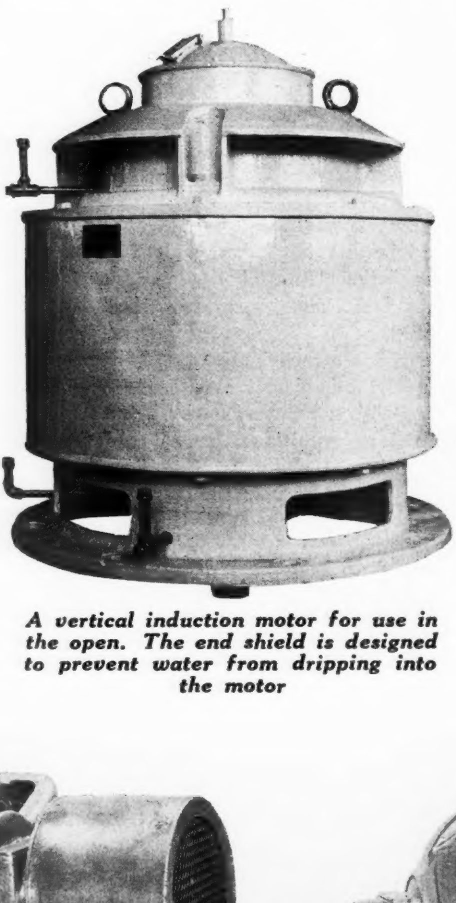
By H. L. Smith
Industrial Engineering Department, General Electric Co.

"WHICH type of motor is best for my purpose?" In answering this question, it is necessary to determine the requirements of a motor which is to operate successfully under given conditions. When considering permanent installations is is always economical to make a preliminary study of the conditions to be met, that an intelligent application of motors may be made and suitable devices installed for their protection.

A motor develops torque and speed, the two elements required to drive any load, but temperature rise must also be considered. To operate successfully, a motor must be of such size and design that it will start and accelerate under any reasonable load which it may be called upon to bear, carry any reasonable overload and also be capable of carrying its normal load for the period of time required without bringing about a temperature rise which would cause deterioration of the insulation.

In selecting a motor, the starting and accelerating torques should be a primary consideration. After the starting torque requirements of the driven machine have been determined, the ratio of starting torque to normal torque should be noted. This ratio, if relatively large, indicates that a slip-ring or high resistance rotor alternative-current motor is preferable to the standard squirrel-cage motor, and a compound or series wound direct current motor should be selected in preference to a shunt-wound machine. A similar method may be used for service requiring frequent starting, and careful consideration of the starting and accelerating torques frequently permits the selection of a motor of a smaller horse power rating than could otherwise be employed.

The point of next importance is the peak load which may be encountered. Ample margin must be allowed between the requirements of the driven machine and the maximum torque developed by the motor. For example, if an induction motor were selected with a maximum running torque only slightly greater than the peak load, it is quite possible that the motor would stall if the voltage should fall at the time this peak load occurred.



A vertical induction motor for use in the open. The end shield is designed to prevent water from dripping into the motor

The next consideration is the horse power rating. This is a measure of the motor's ability to do the required work for a specific period without exceeding the safe heating limit or violating other requirements of successful operation, such as good commutation.

It might be noted here that neither of the ratings, whether 40-deg. or 50-deg., indicates the temperature rise which will be obtained, but simply the limit of the temperature rise which should not be exceeded.

Types of Motors

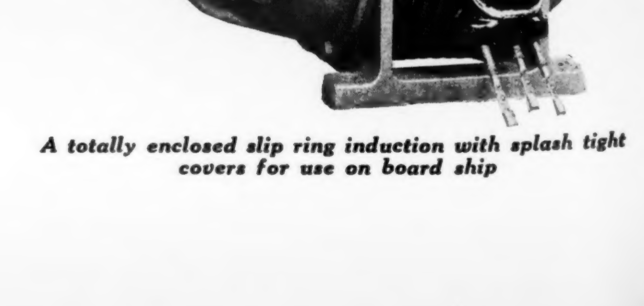
The great number of available alternating and direct current motors can, from a standpoint of speed, be divided into four groups as follows:

1. *CONSTANT-SPEED MOTORS*—The speed of these is either constant, as with a synchronous motor, or does not vary materially with the load, as in the case of squirrel-cage motors, slip-ring motors with rings short circuited, and shunt-wound direct current motors.

2. *MULTI-SPEED MOTORS*—These may be two-, three- or four-speed and may be operated at any one of the several definite speeds, each being practically independent of the load. Examples are direct current motors with two armature windings or induction motors with primary windings capable of various pole groupings.

3. *ADJUSTABLE-SPEED MOTORS*—This group covers motors whose speed can

An adjustable speed, brush-shifting motor

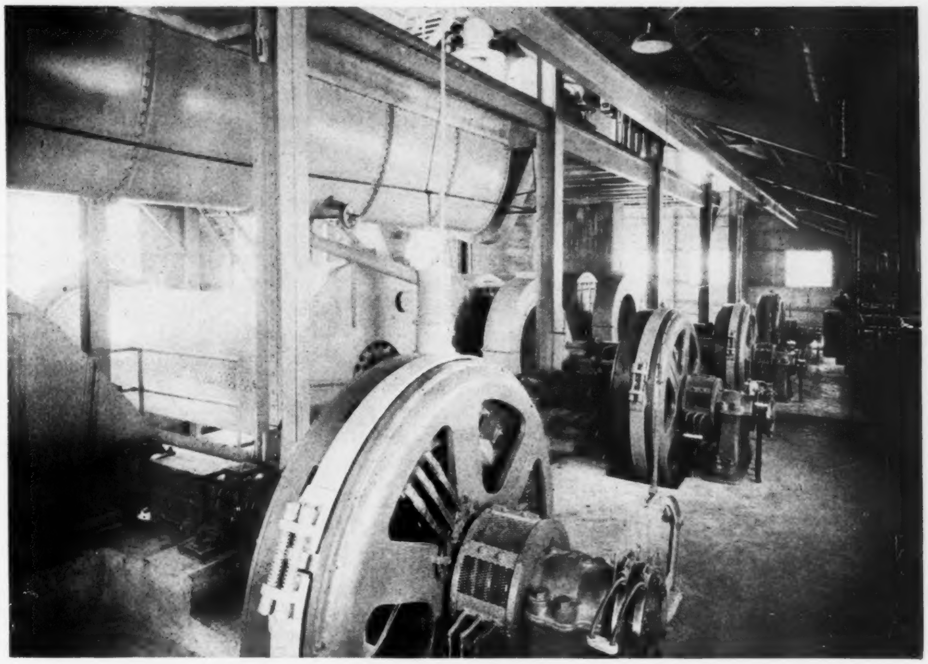


A totally enclosed slip ring induction with splash tight covers for use on board ship

be varied gradually over a large range and, when adjusted, remain practically unaffected by changes in load. Shunt-wound motors designed for speed variation by field control and alternating current brush shifting motors with shunt characteristics are in this group.

4. *VARYING-SPEED MOTORS*—The speed of such motors varies with the load, ordinarily decreasing as the load increases. This covers direct current series motors, compound-wound motors withth light shunt fields and high resistance squirrel-cage motors. As a sub-class of these varying-speed motors there is the adjustable varying speed motor, the speed of which can be varied over a wide range but in which the speed, when once adjusted for a given load, will vary greatly with changes in load. Examples are the slip-circuit and the alternating-current brush-shifting motor with series characteristics.

Whether alternating-current or direct-current motors will be used is generally decided by the type of power available. As most central stations generate alternating current, it is desirable to use alternating-current motors. The alternating-current motor has the advantage of being simple and of sturdy construction, as well as having a low first cost. For constant-speed service, the squirrel cage induction motor is the simplest and is suitable for all applications where the torque required during starting is not abnormally high; the squirrel-cage induction motor is, therefore, the most common motor to be found in any industrial plant. Its one disadvantage is the high current drawn at starting, and, in motors above 7½ hp., it is usually necessary to reduce the voltage applied across the motor terminals at starting. This may be done by inserting resistance in series with the primary winding or by means of a compensator. The first, which is a resistance starter, is cheaper and well adapted for motors up to 20 hp., provided the starting torque required is low (50% of full load). Above this, however, the compensator is more desirable as it has the advantage of a higher torque per ampere of starting current than the resistance type of starter.



Group of super-synchronous motors driving tube mills in a cement plant

Relative Advantages of Squirrel-Cage and Slip-Ring Motors

A line of squirrel-cage motors is now available which are suitable for full voltage starting. On this type the starting current is greatly reduced from that required by the standard type of squirrel-cage motor, especially on high speed units. In the smaller sizes, these motors are designed to give a high starting torque, making them especially suitable for many loads which formerly required the use of slip-ring motors. This type of motor is being widely applied for driving power station auxiliaries, largely because of the simple control required, consisting of a line switch only.

On loads requiring comparatively high torque during starting, it is best to use a slip-ring induction motor, although there are certain cases where high resistance, squirrel-cage motors are suitable. The slip-ring motor has the advantage that the current during acceleration can be limited, this being usually an average of 125% of full load current. This makes a slip-ring motor especially suitable for large sizes and where the capacity of the system is comparatively small, or where the motor is located at the end of a long feeder.

The slip-ring motor is also used where the equipment must be operated at different speeds, these motors being suitable to operate down to 50% speed by inserting resistance in the secondary. It is not advisable to reduce the speed below 50% as the motor has a series characteristic with resistance in the secondary, which may cause instability at less than 50% of full speed.

When a slip-ring motor is operated at reduced speed by using resistance in the secondary, power is wasted in this resistance, this power being practically proportional to the reduction in speed. When the load is such that the motor must be operated for long periods at greatly reduced speeds, it is often more economical to use a brush-shifting type of motor which has a very much better efficiency, as well as power factor, than the corresponding slip-ring motor at reduced speed. For this reason, a great number of series type alternating-current brush-shifting motors have been used for driving mine fans and forced draft fans in power houses.

There are now two types of alternating-current brush-shifting motors, one with the series characteristics and the other with a shunt characteristic. The former is very suitable for such loads as fans and pumps. The shunt type, as its name implies, has a very small change in speed with changes in torque, after the speed has been adjusted for any particular load. As well as being adapted for driving fans and pumps, this type of motor is especially suitable for driving stokers, etc. This motor is especially suitable for any load requiring adjustable speed on which the variation of speed changes in load must be small.

Synchronous Motors

Another type of alternating-current motor which has a wide field of application, but which has not been as extensively used as the induction motor, is the synchronous motor. This type has a constantly increasing scope of usefulness. Among the various applications may be mentioned the driving of motor-generator sets, rock crushers, centrifugal and reciprocating pumps, fans and blowers, tube, ball and other cement grinding mills, etc.

The synchronous motor is especially suitable for direct connection to machines operating at relatively low speeds. An induction motor, when designed for a great number of poles to operate at a low speed, has a very poor efficiency in small sizes and an even worse power factor; the synchronous motor for the same condition has a relatively good efficiency and is even cheaper. For this reason, the synchronous motor has probably found its greatest field in driving low speed machines similar to air and ammonia compressors.

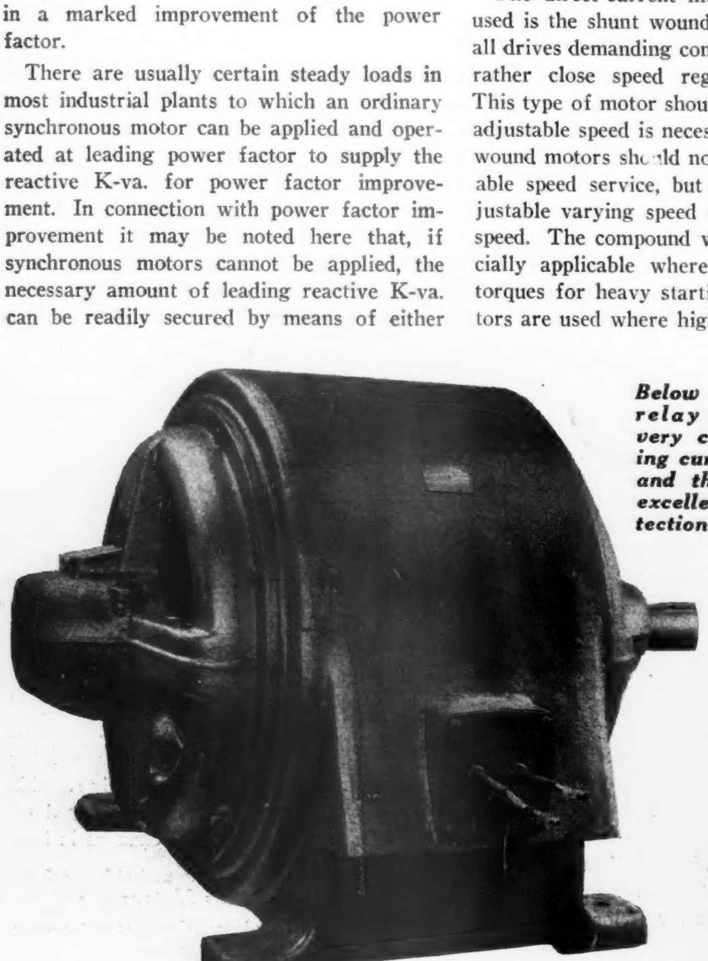
Synchronous motors today are made self-starting and synchronizing and are equally as reliable as induction motors. One distinct advantage of the synchronous motor is that it can be operated at unity power factor or at a leading power factor. Operating at a leading power factor, these motors furnish reactive K-va. for power factor improvement at a minimum cost.

Investigations are continually showing that most plants are over-motored. Often a re-

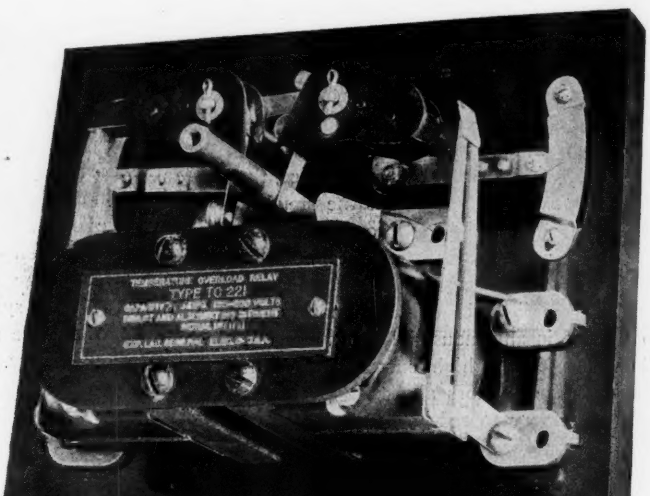
arrangement of motors, allowing each motor to operate close to its rated load, will result in a marked improvement of the power factor.

There are usually certain steady loads in most industrial plants to which an ordinary synchronous motor can be applied and operated at leading power factor to supply the reactive K-va. for power factor improvement. In connection with power factor improvement it may be noted here that, if synchronous motors cannot be applied, the necessary amount of leading reactive K-va. can be readily secured by means of either synchronous or static condensers, allowing the motors, in general, to be of the simplest possible type.

As a synchronous motor operates as a squirrel-cage induction motor in starting, it is not suitable for starting heavy loads. A special type of synchronous motor has been developed, known as the "super-synchronous" motor, to meet these conditions. The essential difference from the ordinary synchronous motor is that the stator frame is so arranged that it can rotate and is also supplied with a hand brake. This motor is started in exactly the same manner as an ordinary synchronous motor, but instead of the rotor turning, the stator revolves and comes up to full speed, at which time field voltage is applied and the motor is synchronized. The hand brake is then applied to the stator, gradually reducing the speed, the rotor starting up at the same time. The braking on the stator is increased until finally the stator comes to rest, at which time the rotor is revolving at synchronous speed. The great advantage of this motor is that it exerts maximum pull-out torque for starting and accelerating the load, making the motor well adapted for drives which are entirely unsuited for operation by the standard type of synchronous motor, without requiring the use of magnetic clutches.



A high speed pump motor with self-ventilating features especially suitable for use in mines



Below — Temperature relay which follows very closely the heating curve of the motor and thus affording an excellent means of protection against overload

Direct-Current Motors

The direct-current motor most commonly used is the shunt wound type, applicable for all drives demanding constant load and where rather close speed regulation is required. This type of motor should also be used where adjustable speed is necessary. The compound wound motors should not be used for adjustable speed service, but are suitable for adjustable varying speed or so-called constant speed. The compound wound motor is especially applicable where loads demand high torques for heavy starting duty. Series motors are used where high torque is demanded and where high speeds and light loads are not objectionable; these motors, however, should not be belted.

Motor Protection

There are three different means of overload protection: (1) Fuses: (2) Overload relays—instantaneous trip, and (3) Overload relays with time delay. These last may be of the thermal type (either adjustable or non-adjustable), in which the time delay is inherent, or of the plunger type, in which time delay is secured by a dashpot or bellows.

The fuse is the oldest form of overload protection and possesses a certain inherent time delay; i. e., it will not blow instantly at current in excess of its rating but, if this excess current is left on long enough, the fuse will blow. This time interval, however, varies considerably with the same rating of fuse made by any one manufacturer and the same rating of fuse made by other manufacturers. Due to this inconsistency in fuses, they do not give proper overload protection for motors.

The squirrel cage induction motor, the most popular motor in this country today, takes from five to eight times full load line current when started on full voltage and, even when started by means of a compressor or resistance type starter, takes two or more times normal current. Thus any fuses protect only against short circuit in such service unless a double-throw starting switch is used, and even then the chances are that the constant blowing of a fuse will result in the use of larger fuses until, eventually, no overload protection is provided.

On slip-ring motors and direct-current motors a fuse of about 125% full load motor current is used and is generally satisfactory in starting, but the same general statement applies; i. e., the constant blowing of a fuse on overloads will result in the substitution of a larger fuse. Although a fuse does not give proper overload protection for a motor, it does give very good short circuit protection and is, therefore, well adapted for use in conjunction with other types of motor protective devices.

The second form of protection is the overload relay with instantaneous trip. This trip is usually set at 160% full load current and should only be used for special applications where the device must be stopped instantaneously at a certain load.

The third form is the overload relay with time delay. On squirrel-cage induction motors, this must be set so high as not to trip under starting conditions, and this setting is usually 125% of full load. On direct-current and slip-ring motors a setting of 110% full load generally takes care of the starting conditions. It may be pointed out here that this type of relay has both a current setting and a time setting, and frequently these two are confused. Properly applied and adjusted, this type of relay gives good motor protection.

Thermal Type Cutout

The fourth type is the thermal device, which is the latest form of motor protection. Motors driving loads requiring high starting torque, such as on cranes, hoists, rolling tables, etc., must have very large fuses of high settings of relays, which means that

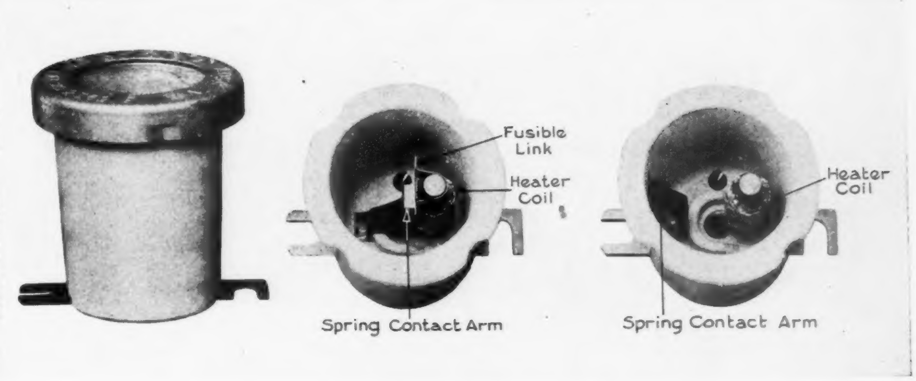
short circuit protection only is provided. Further, every motor is capable of carrying a heavy overload for a short period of time and this period is longer than that given by the commercial form of instantaneous of time delay overload relay.

If the relay is set high enough to preclude operation on the short time overload the motor can stand, it leaves the motor without adequate protection in case of a prolonged overload which would not trip the relay, but be sufficient to burn out the motor. As long as a motor performs its duty and does not reach a dangerous temperature, there is no reason for disconnecting it from the line, even if it should be carrying overload for a time. It is evident that a motor which is just starting up and is cold can carry an overload for a longer period of time than the same motor could if this overload occurred when the motor was already hot. The commercial form of instantaneous or time delay overload relay cannot take these points into consideration.

The ideal form of relay would be one that follows the thermal characteristic of the motor very closely. Thermo-couples in the motor winding meet this requirement very well but are too expensive, except for the larger sizes of machines. The thermal devices just mentioned under the fourth group come nearest to fulfilling these requirements. There are two forms of this relay; non-adjustable and adjustable.

A non-adjustable form is the thermal cutout. There are two forms of the adjustable device: The cheaper is one in which the current to the motor flows through a coil, heat from which is radiated to a strip of metal which expands and trips the device. This relay follows the heating of the motor quite closely during ordinary operation. The other form is made of two elements, the one a mass of iron corresponding to the iron in the motor, the other a heating element corresponding to the windings of the motor. The operation of the relay is dependent upon the expansion of a strip of metal which, due to the above arrangement, follows the thermal characteristics of the motor extremely close. These thermal devices are not suitable for short circuit protection but, used in conjunction with fuses back in the line, give the best form of protection.

Thermal cutouts are now furnished with a marking indicating the maximum rating of fuse with which they can be used. If the fuses in the line exceed this rating, it is necessary to add a set of fuses which will come within this rating to provide short circuit protection. Magnetic switches are becoming increasingly popular because of their simplicity of operation and convenience in location. A complete line of these using the thermal overload devices just mentioned, is now on the market.



Thermal cutout used for the protection of small motors

Wiring for Motors

The next point to be considered is the selection of wire between the mains and the motor. A squirrel-cage induction motor draws a large current during starting. This current decreases as the motor comes up to full speed, but the decrease is not rapid until the motors have increased in speed to approximately 60% of full load speed. As the fuse or overload relay setting is dependent not only on the current but also on the time, it can be seen that, on a load requiring heavy starting duty, the motor will not accelerate as quickly as one having a light starting duty. Therefore, on the former, the large current will last for a longer period, necessitating a larger fuse than on the same motor handling a load having a light starting duty. This in turn, means a larger size of conductor must be used between the mains and the motor.

Carrying Capacity of Wires

Section 610 of the National Electrical Code gives the allowable carrying capacity of wires. These capacities were made up many years ago. Since then, insulation has been vastly improved and it is now believed that a greater amount of over-fusing of these wires is permissible. On squirrel-cage induction motors, it is necessary to have the fuses protecting the mains large enough to carry starting current. These fuses, therefore, have, to be from 200% to 300% of the full load motor current. As the selection of the size of wire is determined by these fuses, the code specifying that the cápacity of the fuses shall not exceed the carrying capacity of the conductors, it means that the conductors must be correspondingly increased in size over the 110% minimum rating.

In selecting the size of conductor we are, however, permitted to use Table C. which means that a certain amount of over-fusing of the conductor is secured and indicates that the conservativeness of the current capacity under Table A is appreciated.

For example, if a motor requires a fuse rated 100 amperes in order not to blow during the starting period, we can, in accordance with Table C, use a No. 3 B & S wire. Table A gives the current carrying capacity of No. 3 B & S as 80 amperes, meaning that the wire is over-fused 20%. It is probable that a motor requiring this 100 ampere fuse would have a full load current in the neighborhood of 50 amperes.

Joints Sealed Against Oil Leaks by New Paint

A PAINT which is said to be the only material that effectively seals joints against oil leaks has been developed by the General Electric Co. and is sold by the merchandise department at Bridgeport, Conn. The product, known as G-E No. 880 Red Protective Paint, also prevents water and gas leaks. It can be used for many purposes which require red lead or white lead, and is less expensive than either.

The paint, which is dark red in color, requires no priming and can be applied by brushing or dipping. Denatured alcohol is used as thinner. It dries rapidly and produces a hard, smooth, glossy film which is easily cleaned and which prevents excessive collection of dirt and conducting material, thereby decreasing surface leakage and subsequent carbonization of the surface when used with electrical apparatus.

One of the first fields in which the paint has been applied is in the manufacture of fuel oil burners, in which one company is now using the material to seal all joints. Other fields in which there will be applications for the paint include plumbing, chemical plants, repair and service shops, packing houses, ship yards, central stations, electric railways and mines.

Better Employer-Employe Relations

THE old type worker, who was contented with doing the job he was told to do and no more, is, in the opinion of the Department of Manufacture of the Chamber of Commerce of the United States, rapidly disappearing. His place is being taken by the employe who takes the trouble to know that his job is all about, what part he plays in his industry and what the problems of that industry are. "There is no doubt," says the department, "that the better employer-employe relations existing in industry today are due not alone to good wages, but also to enlightened study and attention being given to the human element. What about tomorrow? Is it a responsibility which we can afford to dodge?"—*National Bulletin* of the Association of Building Trades Employers.

New Machinery and Equipment

Safety Hopper Car Wrench With Ball-Bearing Head

A SPECIAL wrench, known as "Swaco," for opening and closing hopper cars has been placed on the market by the Safety Wrench and Appliance Co., Springfield, Mass. The feature of the wrench is absolute safety under all conditions, according to the manufacturers, and through its use in opening car doors of even the most obstinate kind, the workman is said to be protected from injuries common in the use of car wrenches.

New hopper car wrench showing handle offset to clear car ribs and ball bearing head

The automatic safety feature throws the top panel to a safety position when the wrench is lowered. To operate it, the car-dog is held up and the wrench lowered, allowing a panel to spring out and the car door to drop. In the case of a sticking door, it may be forced open through the use of the wrench by raising the handle and pressing down. The opening or closing of doors is controlled by turning a trigger switch.

The wrench is made from electric steel and is said to have few parts. It has a ball-bearing head and the trigger is bronze-bushed. The weight of the wrench is 27 lb. and the length of the handle is 36 in. It is made with a 2-in. square opening (M. C. B. Standard) and is equipped with an additional socket, 1½ in. square, to fit smaller spindles which come on some older types of cars.

New One-Yard Power Shovel

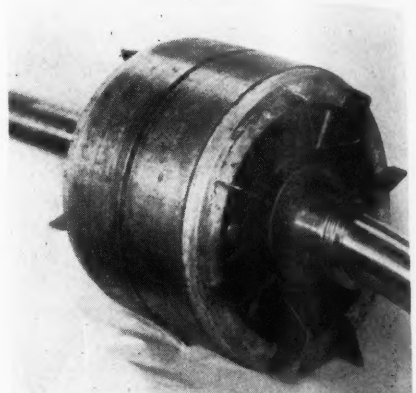
THE Thew Shovel Co., Lorain, Ohio, has recently brought out the Lorain-60, a 1-yd. power shovel, convertible to crane or dragline. The design is said to include all the features of the larger model, Lorain-75, a 1¼-yd. shovel. Power plant, power take-off and counterweight of the new model are less than the Lorain-75, having been stepped down to meet the 1-yd. capacity. The machine is said to be able to handle a 50-ft. boom, and can be counterweighted for increased stability. Substitution of the 75 power plant and accessories in the new 60, will provide a full 1¼-yd. machine, the manufacturers say, should the operator desire a larger machine at any time.

New Type of Induction Motor

A NEW type of induction motor which, with its control, is said to be simpler to operate than the ordinary squirrel cage motor and compensator, is announced by the General Electric Co., Schenectady, N. Y. A complete line of these motors, bearing the type designation FT and ranging in ratings from 7½ to 50 h.p., has been placed on the market.

The FT motor is in general suitable for application wherever the ordinary squirrel cage induction motor with a compensator has been used. It is designed to start on full voltage giving slightly higher starting torque but approximately the same starting current as the ordinary squirrel cage induction motor started with the compensator connected to the 80% tap.

In appearance the new motors are the same as the ordinary squirrel cage induction motor. Rotors are of the cast aluminum type with bars so shaped and located in the punchings as to give a high reactance effect at starting. Starting current is within the N.E.L.A. limitations up to and including the 30-hp. size.



Rotor of new type of induction motor

Control apparatus required is said to be quite simple. An ordinary line switch of proper capacity can be used, but, in order to obtain proper overload and undervoltage protection, the motors, are recommended for use with magnetic starting switches using push button control. Where necessary, on the larger sizes, a compensator or resistor starter may be used as in the case of the ordinary squirrel cage induction motor.

The advantages claimed for this motor

New 1 yd. power shovel convertible to crane or dragline

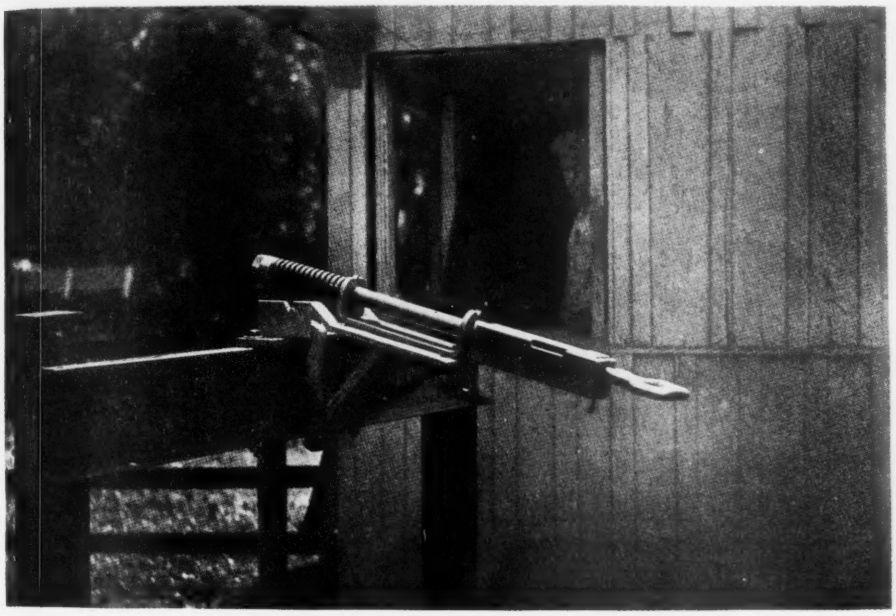
are low cost, simplicity, reliability, low starting current permitting the use of a line switch, elimination of the possibility of abuse by inexperienced operators, and ready adaptation to automatic control by pressure governor, float switch, etc.

New Cement Kiln Gun

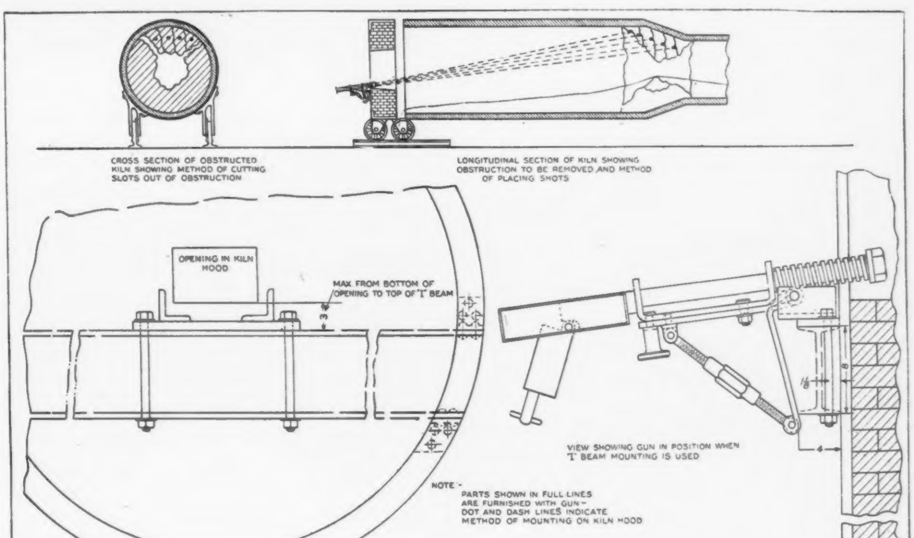
A RECENT issue of the Hercules *Mixer* carries a description of a new cement kiln gun designed to break up the clinker rings in rotary kilns. This is a new development of the Western Cartridge Co., East Alton, Ill. The use of guns for this purpose is not entirely novel, a description of an adapted machine gun shooting ¼ lb. blunt end projectiles appearing in ROCK PRODUCTS, April 5, 1924, issue. The gun developed by the Western company differs in several respects from this and other guns. It has an 8-gage bore with a 30 in. barrel and consequently develops higher velocities than the shorter barrel guns. The barrel is chambered and bored so as to utilize efficiently gases developed by the combustion of the powder.

The working drawing and photograph of the actual gun give an excellent idea of how it is used as well as the construction and sturdiness of the gun. The receiver is case hardened and formed from a solid block of special steel. The breech block is solid and when in position ready to fire prevents any escape of gases backward into the mechanism. The gun is provided with a positive automatic ejector encircling about half the diameter of the shell, which facilitates rapid fire and insures extraction. The gun is equipped with a positive safety sear which prevents the discharge of the piece until the breech lock is entirely closed and locked, thus rendering it absolutely safe in every respect to the operator, it is claimed.

The ammunition for this gun is also manufactured by the Western Cartridge Co. It is known as the Western 8-gage cement gun shell and is loaded with "Herco" progressive burning shotgun powder. It carries a solid cylindrical lead slug weighing 3 oz. of an alloy designed to resist fragmentation at the instant of impact, so as to develop the greatest possible smashing power.



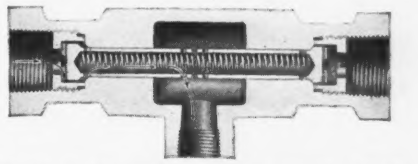
New cement kiln gun for breaking up clinker rings



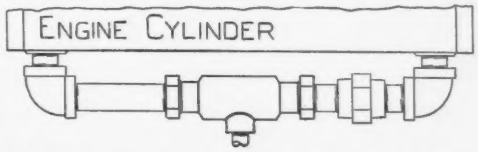
Illustrating the method of mounting and firing new cement kiln gun

New Automatic Drain Valve

THE "Michael" automatic drain valve for use on steam cylinders to remove entrained water and condensation from the cylinders during operating periods and which is said to keep the cylinders drained while idle has recently been brought out by the Sherwood Manufacturing Co., Buffalo, N. Y. Through its use, the manufacturers say, all packing or cylinder head blow-outs and damage are eliminated. With this device, economy of steam and greater output of useful mechanical work are said to be obtained because the continuous removal of water as quick as it enters or forms prevents excessive cooling of the cylinder, and protects the lubrication. The film of oil is said to remain between the cylinder and piston rings and between rod and packing because the steam remains comparatively dry. Wear and renewals at these points are retarded with corresponding lower maintenance expense and preservation of original mechanical efficiency, the manufacturers say.



Section through new automatic drain valve



Showing new drain valve in attached position

With reference to the sectional view shown above, the valve operation is described by the manufacturers as follows: Both valves in the device normally stand open. Steam entering one end of the cylinder closes the corresponding valve. The movement of the engine piston forces water through the other valve (shown open at the left) into the outlet chamber, and reversal of the piston reverses the valve action.

The device can be attached to the various types of stationary, portable and marine steam engines, steam pumps and steam locomotives. On locomotives the Michael drain valve is said to have advantages over the usual type of hand-operated valve.

Sand and Gravel Shipments on Ohio River Show Heavy Gain

SHIPMENTS of sand and gravel in the Huntington, W. Va., district of the Ohio river during the month of March increased 15,291 tons over a similar period of 1926, according to figures compiled and released recently at the office of Maj. Harry M. Trippe, United States engineer here in charge of the district. The total amount of sand and gravel shipped in the district during March, 1927, amounted to 114,294 tons, while the records for the same during 1926 show only 99,003 tons were shipped.

The total freight shipped in the Huntington district this March amounted to 434,642 tons. This is slightly below the total shipped during March, 1926. A high water stage has been reached on the river several times during the month and traffic has been so hampered that a decrease in traffic was the result. The total freight shipped during March, 1926, amounted to 439,911 tons, a difference of 5269 tons.

The major shipments for March, 1926-7, are, coal, 1927, 262,600 tons; 1926, 270,140; iron and steel, 1927, 42,658; 1926, 43,637; oil and gas, 1927, 6600; 1926, 18,848, and sand and gravel, 1927, 114,294 tons and 1926, 99,003 tons.—*Huntington* (W. Va.) *Advertiser*.

Denver Gravel Producer's Truck Delivery Fleet Pays Safety Dividends

THE methods of the J. W. Brannan Sand and Gravel Co., Denver, Colo., by which its truck delivery fleet has cut down on the number of accidents, traceable directly or indirectly to it, have brought forth favorable mention in the *Rocky Mountain News*. The Brannon company has been operating in Denver for more than 30 years. It now supplies sand and gravel to Denver builders from nine gravel pits. Last year with a fleet of 17 trucks of from one to five tons capacity that covered 450,000 miles only one accident occurred in which the company's driver was at fault. In this accident the damage paid for by the company was only $37.50.

A set of rules for which the drivers are held strictly accountable has done much to reduce accidents, according to Mr. Brannan. The rules follow:

1. Never force your right of way. Give rather than take it. Whether right or wrong yield the right of way rather than risk an accident.
2. Carry no passengers. Not even a member of the driver's family is permitted to ride the truck.
3. Never permit children to jump or ride on the truck.
4. Pass children and schools with caution and slowly.
5. Avoid passing hospitals with heavy trucks either loaded or empty.
6. Be courteous, always.

Others rules on bulletins are issued to meet the turn of the times.

And the safety work has been made to pay in real money for, according to the report, the insurance has been reduced about 40% in the Brannan company's case. Further, only personal liability insurance is carried on the fleet of trucks.

H. C. Boyden Joins Celite Products Company

COL. H. C. BOYDEN, well known lecturer on cement and concrete has joined the staff of the Celite Products Co., Los Angeles, Calif. He will deliver a series of talks on the workability of different concrete mixes and the effects which this factor has on costs, quality, appearance, etc. These lectures are to be presented principally to engineering societies and associations, engineering colleges and also to general clubs and other organizations in cities of the United States and Canada.

Col. H. C. Boyden

Colonel Boyden has had a wide experience in concrete work and design and has been connected with the concrete industry for the past 25 years. During the world war he served with the U. S. Army engineers and in 1919 taught at the engineering school at Camp Humphries, following which he joined the Portland Cement Association in the capacity of international lecturer. After six years lecturing he joined the faculty of the Ohio Northern University as dean of the college of engineering.

G. S. Brown Sees Good Year for Cement Industry Ahead

SPEAKING before a group of Portland, Ore., business men, G. S. Brown, president of the Portland Cement Association, and also president of the Alpha Portland Cement Co., said that the general outlook for the cement industry in every part of the country seemed to be quite optimistic. The following from the Portland (Ore.) *Journal of Commerce* quotes Mr. Brown as saying:

"Despite the current talk that building is falling off in some localities, business seems to be on the up-grade, rather than the downgrade.

"It is a fact that construction on certain types of buildings is not going forward as rapidly now in some sections as a year ago, but this is more than counter-balanced in other building lines. Construction of homes seems to be falling off slightly in some parts of the country; road building remains about the same, while orders are constantly increasing for materials for constructing and repairing city streets."

He declared that the construction of industrial buildings seemed to be about the same, while railroads are expanding as indicated by orders for cement. The building of docks, power dams and other heavy construction is increasing, said Mr. Brown.

"The capacity for the production of cement is greater at the present time than ever before," said Mr. Brown. "The manufacturers are in position to produce 225,000,000 bbl. of the product, which is half again as much as the present demand. Foreign manufacturers, because of cheap labor conditions, which, in some cases, enables them to secure help at one-fourth the wages we are paying, are able to compete easily with American manufacturers and still make a substantial profit.

"Wages in this country, not alone in the cement industry, but in nearly all lines, are higher than they have ever been before, not excluding the years 1919 and 1920, immediately after the war," declared Mr. Brown.

He stated that personally he was not adverse to the paying of high wages, however, taking the viewpoint that the more an employe has to spend above the bare expense of living, the more he appreciates his job and the harder he will work to retain it.

Mr. Brown declared that according to statistical reports, the northeastern states were at present using more cement for building and general construction purposes than any other section of the country. He was loud in his praise for the Pacific northwest, however, and said that no other locality could produce figures showing so rapid an expansion and growth in the construction line per capita population.

Mr. Brown, accompanied by Mrs. Brown and Mr. and Mrs. C. A. Irvin of Chicago, was in Portland recently visiting cement manufacturers in this district as a part of an extended West Coast tour.

News of All the Industry

Incorporations

Nichols Cement Co., 418 Straight Ave., Grand Rapids, Mich., $24,000.

Stone Tile Concrete Products Corp., Lynchburg, Va., $10,000. By C. S. Adam, Rivermont St.

Charles J. E. Anderson Sand Co., Chicago, Ill., is reported dissolved.

Dal-Tex Stone Co., Dallas, Tex., $50,000. By Louis L. Dent, W. B. Palmer and Frank Fay.

McGill Corp., Greensburg, Penn., $5,000. Deal in sand. By H. H. Swaney of Beaver Falls.

M. & W. Cement Co., Dover, Del., $100,000. Deal in cement and cement products of all kinds.

Miller Lime Products Corp., Hudson, N. Y., $50,000. By Charles Bros. of Hudson.

Ottman Sand and Gravel Corp., Mt. Vernon, N. Y., is reported dissolved.

Western Lime Co., Inc., Seattle, Wash., $80,000. By C. B. Limpright, S. P. Westfield and William C. Shaw.

General Gypsum Co. of New York has incorporated in Texas for $10,000. Ide D. White of Austin is Texas agent.

Travertex Stone Corp., San Francisco, Calif., $25,000. By M. W. Morris, M. O'Hara, R. A. Smith, M. Schwab and Wm. Klein.

Merrill Marble and Granite Works Co., Merrill, Wis., $20,000. By A. E. Anderson, H. J. Mitbauer and Lillian Anderson, all of Merrill.

Santa Fe Lime Rock Corp., Gainesville, Fla. By J. W. Geller, R. E. Gulledge and R. O. Hanson.

Bloomer Burkestone, Inc., Wilmington, Del., $500,000. Deal in clays, cement rock, limestone and other ores.

Ryan, Bulkley, Hickey Corp., Brooklyn, N. Y., $1,000,000. Concrete mixers, cement, plaster, mortar, lime, sand, gravel, etc. By J. T. Appbury, 120 Broadway, New York City.

Badger Terrazzo Co., Milwaukee, Wis. Manufacture and sell terrazzo, tiles, mantels, fireplaces, mosaics, etc. By Chas. O'Hara, A. K. Peters and Joseph Tierney.

Fort Sumner Sand and Gravel Co., Santa Fe, N. Mex., $50,000. Deal in sand and gravel. By A. B. Erickson, Fort Sumner; S. F. Shallenberger and Charles Michaelson, Amarillo, Texas.

Superior Sewer Pipe Co., Greenville, S. C., recently opened a new plant at Columbia, S. C., and reports increase of capital stock from $46,000 to $85,000.

Bituminous Coated Stone Co., 127 N. Dearborn St., Chicago, Ill., $30,000. Manufacture and deal in cement and all kinds of building materials. By Rolly E. Lou, B. and Earl F. Jackson. (Correspondent, C. H. Wood, attorney, Quincy, Ill.)

Edw. C. Barta Co., 4636 N. Crawford Ave., Chicago, Ill., $10,000. To mine, quarry and excavate stone and rock of all kinds. By E. C. Barta, Frank Lychamer, Harry B. MacLeod. (Correspondent: Charles Knudson, 160 N. La Salle St.)

Chicago Panel Stone Co., 429 W. Superior St., Chicago, Ill., $50,000. Manufacture, develop and apply composition marble, tile and building material products. By F. J. Schroeder, Jr., G. J. Cannon, C. H. Blackburn. (Correspondent: Jenkins & Kirkpatrick, 1275 Transportation Bldg.)

Decatur Hydraulic Sand and Gravel Co., 143 E. Main St., Decatur, Ill., $6,000. Mine for sand and gravel, carry on construction business. By William A. Bowshier, Ida May Bowshier, Roy R. Wilson. (Correspondent: Lawrence C. Wheat, 422 Milliken Bldg., Decatur.)

Ohio River Dredging Co., Wurtland, Ohio, $400,000. Recover gravel and sand from the Ohio river. This new company comprises the Wilson Sand and Supply Co. and the Ashland Sand and Gravel Co. and announces it will continue existing business. Incorporators are A. B. Rawn, C. W. Sems and J. C. McLester.

Cement

Lehigh Portland Cement Co.'s prize-winning English cottage, constructed as a demonstration of concrete masonry at 6512 Linden Road, Kansas City, Mo., is reported recently sold for $16,500.

San Antonio Portland Cement Co., San Antonio, Texas, conducted a tour of inspection through their plant recently for the Texas section of the American Society of Civil Engineers.

The Portland Cement Association recently gave a demonstration, through Dave Meeker, one of its representatives, on the making and use of concrete on the farm, at Kohoka High School's Vocational Agricultural Department, Kohoka, Mo.

Pacific Portland Cement Co. is reported to have purchased 2800 acres of lime deposit and mineral land in the Oak Creek district, 10 miles west of Mojave, Calif. This deal is one of the largest transactions of mining properties since the first of the year.

San Antonio Portland Cement Co., San Antonio, Texas, is reported to have let contract for the construction of a 200x78 ft., 2-story, concrete and structural steel, clinker shed, to cost about $71,679, at their Cementville plant.

South Dakota's state cement plant at Rapid City is reported will resume operation about May 1.

Trinity Portland Cement Co. recently gave an entertainment and barbecue, at its Ft. Worth plant, to the Lumbermen's Association of Texas. About 1000 persons were in attendance.

State of South Carolina recently completed a survey showing the relationship between the manufacture of portland cement and cotton, its principal money crop. It states that last year South Carolina used 637,681 bbl. of domestic cement and that it required well over a million cotton sacks to ship this in. This year the state highway department will purchase 800,000 sacks of portland cement for use in road work and estimates that 800 bales will be required for the sacks if American cement is used.

Alpha Portland Cement Co. announces that its Chicago, Ill., office has been moved to 165 West Wacker Drive, telephone State 4810.

Cement Products

Southern Cement and Stone Co., Brunswick, Ga., old plant, which has not been in operation for a number of years, is reported to have been purchased by a group of local business men. New machinery and other equipment have been purchased and the company will start manufacturing building blocks, sidewalk cement blocks, etc., soon.

W. D. Haden Co., through its Houston, Texas, office manager, Sid Clark, recently announced it had signed a contract with the National Stone Tile Corp., giving his company the manufacturing agency for "stone tile" products in Houston and the surrounding territory. Equipment has been installed and several thousand units of the tile have been made and are in process of curing.

Plastoid Products Co., Los Angeles, Calif., announces that their engineers have devised a new saw for cutting mineral base wall board.

Sand and Gravel

Prof. E. P. Rothrock, acting state geologist and head of the department of geology at the University of South Dakota, is making a gravel survey seeking deposits in the district between Chamberlain and Rapid City, to be used for highway construction.

Greenville, Miss., the center of various gravel interests, is reported under a few feet of water. Most of the population has been moved to Vicksburg. The water and light plant is protected and the situation is said to be well in hand.

Little Rock Sand and Material Co., Little Rock, Ark., is reported to have had its plant, at the foot of Big Rock, undermined by the high water in the Arkansas river. The plant has toppled over into the river along with about 75 ft. of land, causing a loss to the owners of about $20,000. All that was left intact was the office building, a few small boats, some conveyors and part of the pipe line.

Edgar, Mont. The Blum pit near here is reported will furnish about 140,000 yd. of washed gravel to the Northern Pacific railroad for ballasting purposes.

Galesburg Sand and Gravel Co. is reported to have let the contract for stripping at its Gravel Hill property near Buda, Ill., to the Dunker Construction Co. of Davenport.

Bruce, Wis. The Soo Line's gravel pit here will be opened about May 15, it is reported.

Independent Gravel Co., Seattle, Wash., is reported to have added about $2,000 worth of new machinery to its equipment.

Whitby, Ontario, Canada, is reported negotiating with the Department of Highways for the purchase of a gravel pit owned by the department but for which it will have no use for some time. The gravel is badly needed for road construction and repair work by the town.

Iron City Sand and Gravel Co., Bessemer Bldg., Pittsburgh, Penn., is reported to have acquired the Ohio River Gravel Co. of Parkersburg, W. Va., recently.

Horicon Sand, Gravel and Tile Co., Horicon, Wis., is reported to have recently sold all of its equipment at public sale.

Dempster Construction Co., Hopkins county, Ky., is reported to have purchased a 200-acre gravel deposit at Millport, Muhlenburg county, and will install new specially designed gasoline equipment at the pit. The company reports orders for over 100,000 tons of gravel for use on Kentucky highways.

Yellowstone county, Mont., is reported to be installing a new 300 yd. per day capacity Cedar Rapids crusher at its gravel pit near Spurling siding. The stone crushed will be used for road work.

Evansville, Ind., reports that the gravel fleets on the Wabash and Ohio rivers have resumed operations, are very busy, and anticipate large volume of business due to the extensive building program in the Evansville district.

Silica Sand

Berkeley Glass Sand Co., Cumberland, Md., with Henry P. Bridges of Berkeley Springs, Va., president, is reported to have acquired additional sand deposits near here.

Ottawa Silica Sand Co., Ottawa, Ill., is reported to have purchased 38 acres of sand and mineral deposit land just west of the city limits and adjoining their plant and property, at the reported sum of $38,000, or $1,000 per acre.

Quarries

Bradentown, Fla. A large deposit of dolomitic limestone near here is reported to be under development by a company financed by Maj. G. L. Jones and associates, owners of the property. Only three feet of overburden is said to cover the first stratum of the stone, and this is removed by a

crane equipped with clamshell bucket. Operations are said to be under way.

Bloomington, Ind., it is rumored, will soon have a new stone company, to be organized by Henry A. Woolery. He is reported to have leased 250 acres of land which has been core-drilled and shows a good grade of stone.

Al Jayne Quarry, Nicholson, Penn., which has been idle for several years, it is rumored, will be operated by Scranton, Penn., parties this season.

Moses Shields Quarry, Binghamton, Penn., which has been closed for about 12 years and is about the oldest quarry in this section, having been opened by Moses Shields, Sr., and his brother Thomas 50 years ago, is reported will be put into operation by parties from Binghamton.

Pompton Junction, N. J., quarry is reported will be opened soon and a stone crushing plant erected.

Gilmore City Portland Cement Co.'s quarry at Gilmore, Iowa, is reported has been opened and it is stated that the plant will not make cement this year. The crushing plant will be operated to produce commercial crushed stone.

Gypsum

Antigonish Harbor, Canada, gypsum properties have recently been investigated by S. A. Stephens of the Dominion Cement Co. of Montreal, preparatory to starting reported work this summer, dependent upon the completion of federal dredging operations commenced two years ago.

Cape Breton's extensive gypsum deposits have seen a marked increase in activity during the last few years, due to the growing market in the eastern states for the output, either raw or refined.

The Canada Cement Co. is reported to have secured a number of claims in the gypsum area around Antigonish No. 5 and it is rumored will operate the area on the north side of Antigonish Harbor. This company is contemplating the installation of a crushing plant this year, to include a shipping pier and a standard gage railway. It is doubtful if shipments of gypsum will actually begin before 1928 because of the amount of dredging yet to be done to complete the harbor to allow the larger tonnage vessels to enter.

Standard Gypsum Co., Long Beach, Calif., is reported making changes in the operation of its derrick at the wharf on slip No. 4. The boom of the derrick is being rearranged so that it will slide instead of swing, making it possible to unload the gypsum from the hatches of the boats into the bins more readily. The cost is estimated at $10,000 and will require about three weeks to complete. C. T. McGrew & Sons are doing the work.

Lime

Radford Limestone Corp., on Little river, Radford, Va., is reported to have resumed operations after a three months' shutdown due to extensive improvements and alterations. They have installed a new crusher, two new screens and a conveyor belt, as well as a lot of improved electrical equipment. The plant has an output of 2000 tons per day and employs an operating crew of 75 men.

Miscellaneous Rock Products

Kentucky Rock Asphalt Co., Louisville, Ky., reports a tonnage increase of 2½ times over that of last year.

Blacksburg, S. C. It is rumored that valuable mining properties here will soon be developed by northern capital. The properties contain deposits of asbestos, graphite, barytes, potash feldspar, lime, shale rock and large quantities of building granite, as well as gold, silver, copper, etc. A reduction plant producing barytes is in operation and is making shipments to various parts of the country.

Rocky Mount, Va., recently reported that the mica mines at Chestnut Mountain in Franklin county were purchased by Ryland Goode, W. E. Woody and N. E. Prillham, who will operate.

Hold-Tite Manufacturing Co., 316 Bethel Ave., Tarrant City, Ala., a recently organized company, has completed new plant to manufacture asbestos and allied products, with T. C. Crowley as manager.

Obituaries

W. J. Sparks, president of the W. J. Sparks Co., Mt. Vernon, Ky., died April 16 of a paralytic stroke at his home in Louisville, Ky.

Joseph Grass, president of the Granite Concrete Stone Co. of Milwaukee, Wis., recently died of injuries he received when struck by a speeding automobile.

William M. Farnham, Buffalo, N. Y., manufacturer's agent for the Michigan Limestone Co., died here recently from injuries received in an automobile accident.

Personals

M. E. Young, Rapid City, S. D., who for several years past has been the auditor of the state cement plant here, is reported to have resigned in order to take charge at Muscatine, Iowa, of the Muscatine-Burlington Northwestern railway line, as general superintendent.

L. R. Ferguson, New Orleans, La., manager of the Louisiana Portland Cement Co., recently gave a talk on "Cement, Its Origin, Manufacture and Use," at the Forum dinner of the New Orleans chapter of the American Institute of Banking.

Dwight Morgan, formerly sales manager, has been promoted to the position of manager of the Virginia Portland Cement Corp.

H. E. Hilts, formerly manager of the Virginia Portland Cement Corp., has been appointed manager of the Cuban Portland Cement Corp., with offices at Havana, Cuba. Both companies are subsidiaries of the International Cement Corp.

D. W. Widmayer is reported was recently appointed western sales manager and manager of the Asbestos Shingle, Slate and Sheathing Co.'s new factory at St. Louis. Mr. Widmayer has been assistant sales manager for the company the past six years. With the completion of the new plant in a short time, all business in the territory west of Columbus, Ohio, will be handled from St. Louis.

Fred Peterson, president of the Quarry Products Co., Menasha, Wis., recently escaped serious injury when he was struck and knocked off of a ledge in the quarry, into a pool of water 12 ft. below, by a broken belt. This is the third time Mr. Peterson has been injured in practically the same way.

J. H. Dalbey, since 1908 with the Dixie Portland Cement Co. of Chattanooga, has recently been appointed southern sales manager for the Pennsylvania-Dixie Cement Corp.

T. A. Wood, general manager of the Basic Products Co., Kenora, W. Va., was principal speaker recently at the regular weekly meeting of the Huntington chapter, American Association of Engineers. His subject was "Basic Cement," and described cement from its first stages until it has gone through all the intervening processes and finally appears a finished product.

L. G. McConnell, formerly vice-president of the North American Cement Co., is reported to have recently been elected vice-president of the Hamilton National Bank of New York City.

P. M. Woodworth, a representative of the Portland Cement Association, is making a tour of the "big cities" and recently stopped in Denver, Colo., where he addressed a gathering of engineers, contractors and architects on "The Design and Control of Concrete Mixtures."

J. E. Zahn, secretary of the United States Portland Cement Co., was recently elected member of the board of the Denver Chamber of Commerce.

Manufacturers

Timken Roller Bearing Co., Canton, Ohio, announces that all the present officers were re-elected for another year. H. H. Timken is president; W. R. Timken, John G. Obermier, Marcus T. Lothrop, H. J. Porter and T. V. Buckwalter are vice-presidents; J. F. Strough is secretary and treasurer, and W. A. Brooks is assistant secretary. Directors are H. H. Timken, W. R. Timken, Marcus T. Lothrop, John G. Obermier and J. F. Strough.

Merco Nordstrom Valve Co., San Francisco, Calif., has removed its New York office from 110 W. 40th St. to 11 W. 42nd St.

George D. Whitcomb Co., Rochelle, Ill., announce the following new distributors: American Machinery and Supply Co., Omaha, Neb., for the entire state of Nebraska and western Iowa; Clyde Co., New Orleans, La., for Louisiana and the southern halves of Mississippi and Alabama. A. R. Amos has returned to the company and is now permanently located at 1014 Harrison Bldg., Philadelphia, Penn.

William Ganschow Co., Chicago and Peoria, announce the appointment of Fred E. Holtz as representative in the Milwaukee territory. The division headquarters will be located at 1246 24th Ave., Milwaukee, Wis.

Brown Instrument Co., Philadelphia, has established a Cincinnati, Ohio, branch at 718 First National Bank Bldg., with J. R. Green in charge.

Dorr Co.'s testing plant and laboratory at Westport, Conn., were totally destroyed by fire of unknown origin recently. The mill was of historic curiosity, dating back to the Revolutionary days and having been successively used as a cotton mill, grist mill and finally by the Dorr company as a place to try out newly developed equipment and old equipment to new industries on a semi-commercial scale. The old water wheel continued in use, driving generators which furnished all the necessary light and power for the tests.

Other buildings on the property were saved. The destroyed mill will be rebuilt immediately.

Foote Bros. Gear and Machine Co., Chicago, Ill., announce the appointment of E. H. Sager as Michigan sales representative.

Bucyrus Co., South Milwaukee, Wis., announces the opening of a branch sales office and repair parts depot at 1737 E. 7th St., Los Angeles. J. H. Sackett, local representative there, will have charge of sales in southern California, under the direction of P. H. Birckhead, western sales manager. W. O. Hahn will have charge of the repair parts depot.

Prest-O-Lite Co., New York, announces the sale of the storage battery branch of its business to a new company, Prest-O-Lite Storage Battery Corp. The entire capital stock of the purchasing company is owned by the Automotive Battery Corp. of New York. That portion of the Indianapolis plant of The Prest-O-Lite Co., Inc., used for the manufacture of storage batteries has been leased to the new company.

Harnischfeger Corp., Milwaukee, Wis., announces the opening of a Baltimore office at 1402 Lexington building, under the management of Daniel J. Murphy, formerly manager at Dallas, Texas.

Heine Boiler Co., and **Ladd Water Tube Boiler Co.** have consolidated their Philadelphia district offices at 807 Bankers Trust building, Philadelphia, Penn.

Trade Literature

NOTICE—Any publication mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention ROCK PRODUCTS.

Mack Trucks. Bulletins illustrating Mack advertising in trade journals. INTERNATIONAL MOTOR CO., New York.

Spray Machines. Bulletins on compressed air painting and finishing machines. MELLISH-HAYWARD CO., Chicago, Ill.

Splash Lubrication System in Marion Shovel. Brochure describing and illustrating the splash system of lubrication in the crowding and swinging engines of the new Marion Type 7, 1-yd. steam shovel. MARION STEAM SHOVEL CO., Marion, Ohio.

Rol-Man Screens. New booklet describing, illustrating and listing applications of rolled manganese steels in the rock products industry. Data on manufacture, qualities and construction of Rol-Man screens for various screen types. Dimension and weight tables. Recommendations for all types of screening purposes, includes consideration of rod sizes, etc. MANGANESE STEEL FORGE CO., Philadelphia, Penn.

Chrome-Nickel Steel in Special Track Work. Bulletin No. 10, a condensed report based on a paper read by G. F. Hibbard, construction engineer, before the Technical League of the Milwaukee Electric Railway and Light Co. Data on special tests, line illustrations and micrographs. THE INTERNATIONAL NICKEL CO., New York.

"Dreadnaught" Bucket. 8-page bulletin describing and illustrating clamshell bucket of lever-arm type. Data on design and construction. Listing of recommended sizes of buckets to meet conditions such as material, hoisting equipment, etc. BLAW-KNOX CO., Pittsburgh, Penn.

Dryers. Brochure giving data on two single shell Ruggles-Coles dryers of 50 ton per hr. capacity installed in a cement plant to handle limestone, crushed to pass 3-in. ring, drying to less than 1% moisture. HARDINGE CO., York, Penn.